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Thesis**: The Space and Place of Food:**

The Relationship between grain import dependency and food security for West Africa

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The space and place of food: The relationship between grain import dependency and food security for West Africa

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Summary

Grain is an important staple in the food basket of the world. Its average consumption has increased over recent decades, especially rice and wheat in the West African region. West Africa's grain demand is constantly increasing and as such, it relies on grain imports. The relative dependence on grain imports to compliment the mismatch between supply and demand for the region has raised security concerns in the wake of the recent global events. The rising food price resulting from climate related changes, use of grains for bio fuels and the increase in population, has also contributed to these security concerns.

The access to grains in West Africa is a security concern. Therefore, to ensure food security, optimisation of grain production is critical. When one compares West Africa's position to Asia and some Latin America countries, these countries have proven that optimisation of their grain production have had a positive impact on improving their food security.

Several studies and reports have stressed the importance of improving domestic production for self -sufficiency and reliability. In addition, improvement of production can also reduce vulnerability to the denial of imports from other trading partners for the purpose of their self-sufficiency. Other studies have also stressed the importance of improving policy resilience and adaptation capacity to changing market trends. It is expected that, the West Africa region with its endowment in arable land, can focus on optimising its potential in grain production to minimize the relative dependence on imports and reduce its subsequent vulnerability.

These studies have shown that grain optimisation can have a positive impact on reducing import dependence of the region. In this regard, the concept of grain optimisation to improve food security was developed as the thesis for this work. The study objectives is to understand grain imports growth over time and the characteristics of West Africa import dependent countries and their sources of supply, whilst examining the determining production and location factors of imports and the factors that need improvement to enhance grain optimisation and food security for the region.

This thesis centers around an analysis of location and production factors of grain cultivation to identify the determinant elements, which have significant impact on the optimisation of grain production. The dominant elements in these factors are institutions ability, infrastructure services, education and technology. The elements also include agricultural indicators such as percentage of arable land, yield per hectare and production quantity. Finally the thesis will show that these determinant elements have a great impact on investment and policy decision relative to grain production and sufficiency.

The study relied on the Food and Agriculture Organisation (FAO) dataset to analyse growth trends in import, export and grain production in West Africa and the rest of the world over the period 2002-2011. Another source of data analysis used was that from the Global Competitive Index (GCI), which is based on the overall competitiveness and resilience capacity of the region.

In order to identify the significant determining factors, the methodology and techniques used were quantitative analysis for the descriptive research and a deterministic model (pooled OLS) and fixed and random effect model for the explanatory section. The descriptive section focused on the growth in imports, exports and production over time. Access to technology, availability of scientific research institutions, extent of market dominance among other indicators were analysed with the regression models in the explanatory section.

The study results showed that major production factors such as increase production yield, research and development in agriculture by higher educational institutions, and producer price index are important for optimising grain production. Location factors found to be critical to reducing import and optimising grain production are transparency of government policymaking, soundness of the banks, quality of scientific research institutions and cluster development for production and production services, including the development of infrastructure services, FDI and technology transfer.

Overall, West Africa needs to transform its region from a relative dependent import country and make optimising grain production a top priority to build resilience to grain imports vulnerability and food insecurity.

Keywords

Grain optimisation, Import dependency, Regional resilience, Food security, knowledge capital.

Acknowledgements

The thesis topic was inspired by the knowledge acquired on urban competitiveness and resilience. The research explores the interconnections of grain imports dependence, optimisation of grain production and food security within the context of building regional resilience for West Africa.

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Abbreviations

AU	African Union
AG	Agriculture
ECOWAS	Economic Community of West African States
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Statistics
FDI	Foreign Direct Investment
FDLC	Centre for Research and Documentation Chile-Latin America
FE	Fixed Effect
GCI	Global Competitiveness Index
GCR	Global Competitiveness Report
GDP	Gross Domestic Product
IHS	Institute for Housing and Urban Development Studies
MDG	Millennium Development Goals
MFC	Metropolitan Food Cluster
MNC	Multi National Corporations
OLS	Ordinary Least Square Methods
R&D	Research and Development
RE	Random Effect
UK	United Kingdom
US	United States
USDA	United State Department of Agriculture
WTO	World Trade Organisation

GLOSSARY

Agro parks: a cluster of high productive plants for production and processing (Source Peter Smeets, 2014) Alterra Wageningen UR.

Betweeness: the strategic position of a country or node in a network.

Cluster development: the concentration of businesses and production processes around and within a location.

Consolidation centres: this is where products are processed and distributed to the market (Source Peter Smeets, 2014) Alterra Wageningen UR.

Degree of consumer orientation: the extent to which businesses respond promptly to consumer preferences and desires.

Destination country: the receiving or importing country or region.

Food security: all people having access to culturally appropriate food at all times.

Foreign direct investment: the investment or export made from a source country to another who is a receiving country (this could be export of knowledge, technology or food import).

Global network: the interactions between, within and across countries or region for purposes of economic returns.

Grain optimisation: Obtaining the maximum grain output by taking advantage of a regions potential to fully exploit its production.

Import dependency: a relationship between a receiver and supplier, in which the receiver cannot provide for itself and is reliant on the supplier to survive.

K-core: a structure that shows the connectedness or groups within the whole network. It brings out the component of blocs or factions in the network.

Knowledge capital: input or resource underpinning growth process.

Market trend: change and dynamics that occur over time, which suggests that network, require diversity in the types of investments made.

Metropolitan food cluster: an extended network of actors in the agricultural supply chain (Source Peter Smeets, 2014) Alterra Wageningen UR.

Network capital: is the relation through which organisation and entity gain access to knowledge to enhance expected economic returns.

Path dependence: the present outcome or evolving consequences of past decisions and history.

Region: classification of countries with common social, economic, physical and cultural characteristics and function organised within or around a portion of the earth.

Regional resilience: the ability of regions and their economies to respond and adapt to significant external disruption.

Rural transformation centres: an education and training centre to improve capacity of farmers for increased productivity (Source Peter Smeets, 2014) Alterra Wageningen UR.

Source country: countries who are suppliers and exporters of grains to West Africa region.

Ties: these are linkages and inter relationships between two entities or regions.

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"...Only restrictions on food imports will allow for the development of domestic food production excluding unfair competition from subsidised products, and thus creating the foundations for a more self sufficient and food secure agriculture"

Olivier De Schutter,
UN Special Rappoteur,
on the Right to Food

Cited from
(Uwe Hoering, 2013)
FDCL Policy Paper
Alternatives to Food
Import Dependency

Chapter 1: Introduction

The background of the study describes the impact of the mismatch between supply and demand of three grains (wheat, rice and maize) in the context of trade and food security. The chapter states the problem; research questions and puts forward the research objectives in a logically structured manner which will be investigated.

1.1 Background of the Study

Urbanisation and Globalisation are renowned driving forces in recent decades of economic development. In the context of food security; the supply and demand mismatch are the resultant effects of such forces (Godfray et al., 2010, and Smith, 2013). The increasing population of Africa projected to rise by one billion over subsequent decades presents a challenge of feeding the continent, hence the concern for food security (Godfray et al., 2010).

Most of Africa and especially Sub Saharan Africa supplements a larger share of their domestic food consumption for grains with imports. The growing dependence on import to supplement domestic consumption especially in the face of recent crises is the current driving force of most policy initiatives surrounding the issue of self-sufficiency and self-reliance (Brooks et al., 2013).

(Smith, 2013) states that aggregate global food production is adequate to feed all people; however, the physical access and the economic access shows the complex pattern of global trade in food (grains) for both developed and developing economies. Furthermore, according to the analysis of a report from FAO, (2013) 'FAO statistical year book-World food and agriculture, Feeding the world', it noted that:

"The geographical concentration of major grain supplies versus the geographical dispersion of demand suggests that trade will continue to be important in fulfilling grain requirements, particularly for wheat and maize. With most production located in the temperate zones of developed countries, increasing requirements in developing economies have increased the dependence on exports of these countries".

(FAO, 2013, p. 132)

Additionally, as stated by Godfray et al., (2010); the economic access to food is an indicator of food availability for people who can afford and may have access to world markets, consequently global trade. Meanwhile, Ng and Askoy, (2008) noted that ensuring food for all, presents significant economic, political and technological challenges. Other challenging issues related to ensuring food for all as presented by Godfray et al., (2010) includes the current global food trade shocks, climate change, energy and feed demand, increasing income and change in consumer preferences (Godfray et al., 2010).

*"750 million tonnes of grain produced are used for animal feed, 1 billion tonnes for food use and 500 million tonnes for industrial use, wasted or use as seed, out of the approximately 2.3 billion tonnes of grains currently produced" (*FAO, 2013, p.129*).* Africa's import as noted in the FAO statistical year book (2013) stated that approximately over 30% of grains consumed in 2010 were imported representing grain volume of 66 million tonnes in 2010.

Brooks et al., (2013) stated that decades of trade relationships at varying scale has the object to complement, the lack and inadequacy of food supplies and other produce. He further

discussed global food trade in relation to food security in terms of self-sufficiency (production) and self-reliance (food available for consumption). The two view points as stated by Brooks, et al., (2013) are debatable subjects in their usefulness for regional policies and urban development, many countries especially developing economies of Africa and Asia have adapted self-sufficient policies and strategies, to enhance their resilience and flexibility in food security (Brooks et al., 2013).

The vulnerability arising from heavy import dependence for cheap and accessible staples and the lingering effects of the 2008 crises necessitates the search for alternatives (Brooks et al., 2013, and Hoering, 2013). In this regard the main focus is on domestic grain optimisation and sufficiency.

1.2 Problem Statement

Africa's potential in the agriculture sector is highly supported by its having plenty of arable land. However, despite its large population engaged in agriculture, its food productivity trails behind, compared to other developing economies of Asia and Latin America (Hoering, 2013).

As stated by Hoering, (2013) the phenomenon of cheap food on the world markets, in the early 1980's, made food imports into Africa very attractive for many governments to feed their urban population rather than investment into the agriculture sector except for cash crop cultivation for exports. Whilst most domestic farmers could not cope with the competition in the food crop sector, the majority of them shifted concentration on cash crop cultivation to the detriment of food crop.

With the end to the cheap food era, most net agriculture exporters are now net agriculture importers in Africa with the huge balance of payment deficits for which the foreign exchange from the cash crops are not able to support (Hoering, 2013). The trend of food import continues to increase for most Africa countries especially in grains (wheat, rice and maize) which is a major staple (Hoering, 2013).The growing dependence on grain and grain related products like bread and noodles and the global competition of grain for feed and bio-fuels as compared to grain for human consumption has impacted on the food supply and demand gap (Godfray et al., 2010).

Furthermore, according to (Hoering, 2013) import is not negative because trade (import and export) are an important part of economic growth and development. However, if it leads to dependency, such as widening the balance of payment deficits, then it becomes problematic. Food imports are regarded substitute or complement to domestic production on one hand and can also make a country more vulnerable to international trade disruptions and coordination failure on the other hand (Brooks et al., 2013).

Global trade volume for grain in the period of 2013 has been estimated, to rise on the average 50% in 10 years (USDA, 2014). North Africa, Sub-Saharan Africa, Asia and Middle East are primarily countries driving the trend of increasing demand as described by (USDA, 2014). Subsequently imports have filled the gap for the growing demand. Table 1 represents African region's (March 2014) grain statistics out of 13 regions of the world.

Table 1: Trade statistics and ranks

Sub Saharan Africa

	Wheat	%	Rank	Rice	%	Rank	Maize	Rank	%
Import	18160	36	4	12465	24	1	2700	9	2
production	6306	12	11	12540	24	5	58261	5	46
consumption	23909	48	5	25196	49	4	59473	5	46
stock	1877	4	11	1519	3	6	7309	4	6

North Africa

	Wheat	%	Rank	Rice	%	Rank	Maize	Rank	%
Import	23400	24	2	545	5	10	12700	3	32
Production	20312	21	8	4889	47	7	5801	11	15
consumption	42762	43	7	4559	43	8	18700	9	48
Stock	11727	12	6	487	5	9	1797	10	5

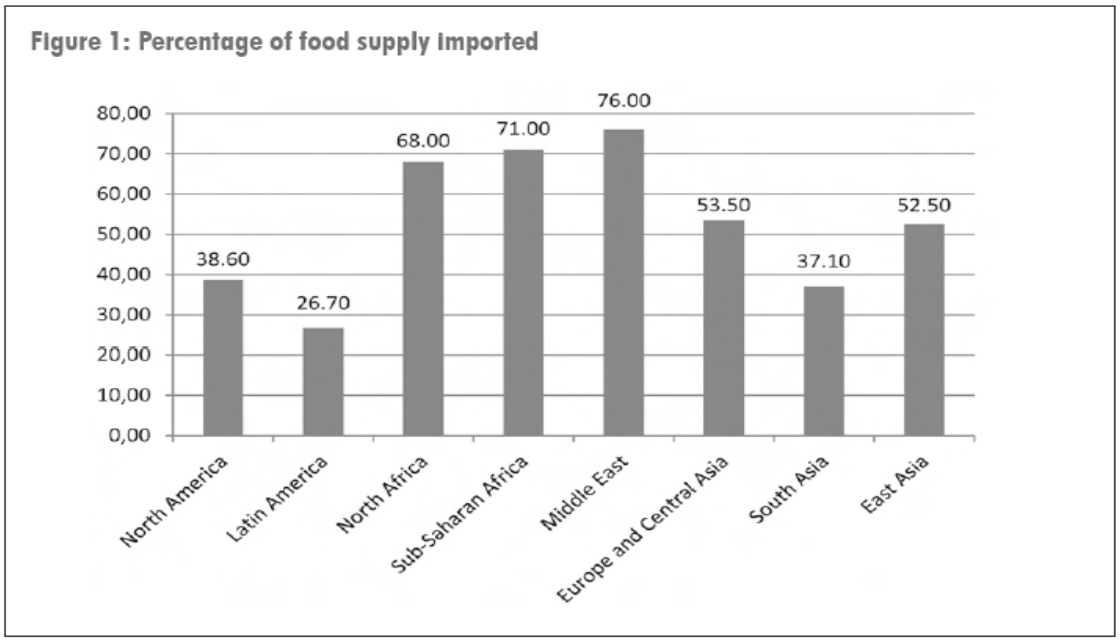
Source: foreign agriculture services/USDA (2014)

Table 1 above and figure 1 and 2 below shows the increasing food supply imported by Sub-Saharan and North Africa. The increase in average consumption in grains by Sub-Saharan and North Africa represents its ranks in the imports of grains. As Africa increases its grain supply through imports, so does the challenge of feeding its population. Indeed Valdes and Foster (2012) noted that food importing countries are likely to remain exposed to world price shocks. In addition Smith (2013) stated that the challenge of feeding the population through imports has a negative effect on especially the urban poor, as higher food prices limit their ability to purchase healthy food.

indeed, Godfray et al. (2010) noted that a better understanding of the effect of globalisation and its externalities on food system is required since on one hand expanded trade can provide insurance against regional shocks on production such as conflict and drought, whilst on the other hand a highly connected food system may lead to wide spread economic perturbation as in the recent banking crisis, thus affecting many people.

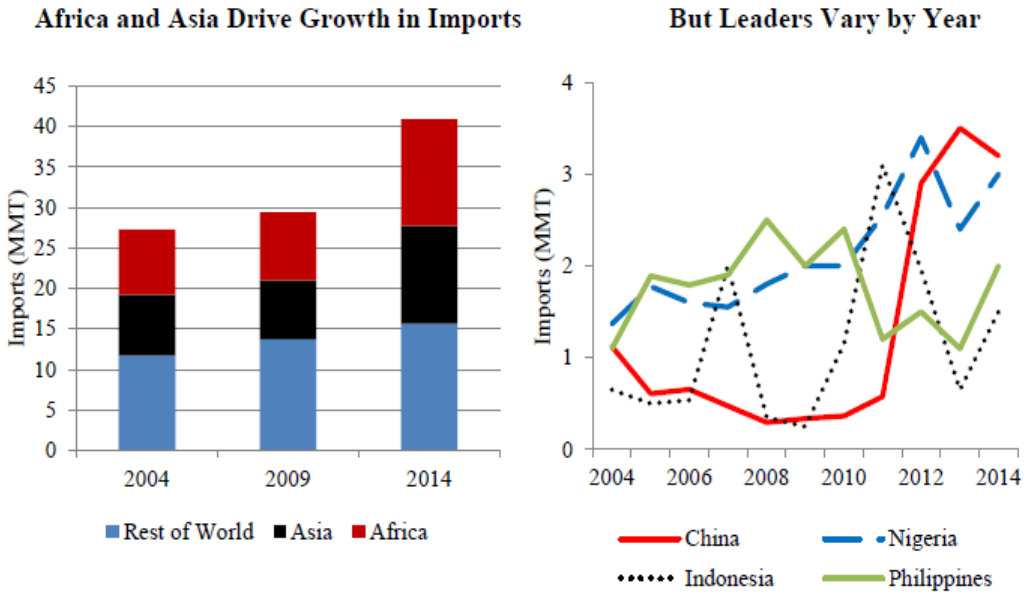
The FAO, (2013) report on world food and agriculture reveals that Africa and in particular Sub-Saharan Africa has 40% of its arable land suitable for agriculture. Considering this potential for food security and the increasing world demand for grains, we can question, why does Africa depend so much on imports of its staples, such as maize, rice, and wheat?.

Figure 1: Percentage of food supply imported



Source: Otago Daily Time, 17 June 2009 in percentage, cited from Hoering, (2013); Alternatives to food import dependency

Figure 2: Drivers of rice import growth



Source: USDA, 2014

Furthermore; with a steady increase in agriculture investment by business and industry, could a new opportunity for farmers to increase productivity and quality of grain be assured? Or

would it generate a new dependency on powerful companies dictating terms and conditions? (Hoering, 2013).

As stated by Sonnino (2009), with grain prices at a record high; "nowhere is the current food crisis more visible than in cities. With negative impact especially on urban residents" (p.425). However, some rural communities who have used most of their farm land for cultivation of cash crops are also victims as net food consumers, thereby experiencing the negative impact.

Tadesse et al., (2013) applied food price spikes and volatility in their estimation to explain that, the supply effect of price spikes and speculations has significant effect on the budget share of a country and on its lower and middle-income class. It again revealed that period over period prices of grains show a significant effects on food security compared to other foods (Tadesse et al., 2013) .

The economic reason to surmount these factor effects, on food supply for developing economies is to build national and regional resilience by optimising production to minimise the impact of food insecurity in grain and vulnerability through import dependency.

Against this background, the study combines the concept of regional de-locking of economic geography and regional planning to define factor opportunities for domestic grain optimisation and its implication to food security for Africans and especially the West African region. It attempts to assess and better understand the relationship between factor opportunities for domestic grain optimisation and reduction of import dependency.

In this context, grain optimisation and its implication for food self-sufficiency and reliance is studied.

1.3 Research Objectives

To examine the mismatch between supply and demand of wheat, rice and maize and its implication on grain import dependency and food security for the West African region.

Another objective is to understand grain imports growth over time and the characteristics of West African import dependent countries and their sources of supply, whilst examining the determining production and location factors of import and the factors that need improvement to enhance grain optimisation and food security for the region.

1.4 Research Question

To what extent does grain import dependency relate to food security for the West African region?

1.4.1 Sub Questions

- What is the growth of import overtime for wheat, rice and maize in the world?
- Which countries have higher import dependency in West Africa and which countries supply the West African region?
- What production and location factors (orgware; software; hardware) determine grain import dependency for West Africa?

- What production and location factors need to be improved to make countries less dependent and optimise grain production for food security in the West African region?

1.5 Significance of the Study

Scientific relevance: Several studies on food security in the wake of the 2008 food crises has led to debates about self-sufficiency and import impact on food security. (Sonnino, 2009, Brooks et al., 2013, Hoering, 2013) and a host of other literature has explained the supply and demand side effects on food security. To this end the study will add to the body of knowledge, the agriculture production and location factors, which have a degree of significance to optimise food security through regional de-locking' of agriculture production in the West African region.

Policy relevance: The research will help urban managers and policy makers to gain insight into the impact of agriculture and location factors on the economic and physical development and resilience of West Africa region.

1.6 Scope and Limitations

Research limited to the grain sector: The scope of food security is limited to grain. Three grains: wheat, rice and maize are being studied within the grain sector. However, these basic food types are the major staples for most West African cities; therefore the study results can be inferred for African food security.

Samples of selected region: The research scope is limited to sample countries in West Africa[1]. Hence, this limits its economic generalisation to all Africa and developing regions. However, the economic trend in the analysis will represent similar trends in other countries and regions.

Database: Professional and reliable secondary databases from FAO and GCI was used in the research analysis. However, some countries within the FAO databases are missing in the GCI database. The assumption is that the provided data for the countries common to both data sources provide valid information to have reliable and valid results that can be inferred for future decisions and research.

[1] West Africa Region: refer to annex for country classification

Chapter 2: Literature review

2.1 Theories and Concepts of the Study

This chapter reviews key theoretical concepts relevant to the research. Cities compete and build resilience through inter dependency. Concepts of economic geography; global networks and trade; regional resilience; and food security form the conceptual framework for this research. The concepts reviewed are:

- Global food network: worldwide integration of the place and space of food,
- Competitiveness: increasing productivity with effective firm and people interaction,
- Metropolitan food cluster: spatial network of physical hub of knowledge and innovation,
- Food security: all people having access to culturally appropriate food at all times,
- Trade: interactions and exchanges that occur for economic returns,
- Regionalism: deepening regional integration of particular groups of countries in trade,
- Resilience: responses and long term adaptability of regional economies to significant external disruption,
- Relational assets: technology, knowledge and creativity access through network,
- Location factors: a region's hardware, orgware and software to facilitate competitiveness,
- Regional lock-in: a recursive specialisation which limit innovation and promote rigidity,
- Regional de-locking: charting a new path on basis of technology, knowledge spillover and localised learning.

2.1.1 Globalisation and Trade

The process of globalisation has integrated nations; facilitated by trade, economic network of production and distribution and spread of investment across nations (Wall et al., 2011). However the volume of economic activities and interactions between countries has remained steady, with relative increase directed specifically towards technological dynamic and specialised production regions (Storper, 1992).

Storper, (1992) in his classical literature on 'the limits to globalisation' centred his argument on technological districts as the advantage to rising share of international trade. According to him, the combination of comparative advantage and technological dynamism reveals the strength of a nation. Other literatures from (Scott and Storper, 2003, Kitson et al., 2004 and Storper, 2009) have reiterated further on the subject of technological dynamism as an important indicator for competitiveness in global trade and value chain.

Within the current global economy; cities and regions network are growing stronger through multinational corporation (MNC) and foreign direct investment (FDI). McCann (2008) revealed that the level of output and trade of MNC and FDI has grown twice as much that of global trade.

Evidently global trade is subordinated to firm investment, as such these global firms benefit from major economic returns from globalisation. Storper (1992) and McCann (2008) noted that with the current trend of global trade, global firms and cities will be the decision making units. Storper (1992) ended his argument on the limits to globalisation to imply that a country is only successful in global trade only if, it understands the nature of the new competition of uneven distribution of contemporary global economic development within the context of technological district. According to Storper (1992):

"*A country is successfully specialised in today's world economy when its share of world exports of a specific product is greater than its share of world trade as a whole (i.e., its imports and exports as a share of total imports and exports of the world)".*

(Storper, 1992, p. 68)

Chortareas and Pelagidis (2004) argue using econometric, descriptive and narrative analysis and highlighting other literature to affirm that regionalism within the main regions of the world in international trade is stronger than globalisation, despite positive international climate associated with transport, technology flexibility and even for countries without substantial trade barriers.

Representing a wider picture, literature by (Storper, 1992, Chortareas and Pelagidis, 2004, Wall et al., 2011, and Hoering, 2013) noted that global trade has not been widely dispersed over countries and that capital flow, jobs and values of export production may be important for developing countries but contrarily implied that they have been relative losers in the process (Storper, 1992; Chortareas and Pelagidis, 2004; Hoering, 2013).

Their argument resonate with Scott and Storper (2003) on the spatial unevenness of world trade concentrated within the triad nations of the north to the detriment of north-south trade relations excluding East Asia. Scott and Storper (2003) further noted that the window of locational opportunity in sector activity should be reinforced for growth opportunity and increasing return effects especially for developing economies to facilitate regional economic development.

In the view of Chortareas and Pelagidis (2004) "*international goods market is nearly not as integrated as they are within regional and national borders*" (p. 269), but noted that the links between regionalism and globalisation may be a competing or complementary processes of global trade.

2.1.2 Competitiveness

The concept of competitiveness; as espoused by Micheal Porter in 1980 is seen as a key ingredient necessary to enhance regional economic growth. The ability of a region to attract capital and sustain its rising market share and better living conditions over time is what (Storper, 1997) described as an indicator necessary for regional competitiveness (Storper, 1997). According to the view of Storper (1997), few key cities and regions are important in generating increasing economic returns that benefit largely its national and regional economies. Therefore, a region's interaction between its human, capital, and natural landscape determines the level of its productivity; which is an indicator of its competitiveness (Porter, 2002).

Despite a host of literature on the concept of competitiveness and its relevance for regional economic policy and development, issues of its elusiveness as described by (Kitson, 2004) still persist. Contrary to Porter (2002), views of (Bristow, 2005, Martin and Sunley, 2006); argue and assert that a region's competitiveness is a function of its past trajectory and endogenous factors shaping its current output in the global economy. Consequently, Rogerson (1999) then questions whether economic policies should reflect on internal conditions shaping regions capacity to sustain growth? Or simply focus on a region's overall rising market share.

The arguments put forward by Bristow (2005) combines the varying perspectives on competitiveness. Bristow (2005) noted that effective interaction between the role of firms to increase regional productivity; the regions role towards firm's rising productivity, shaped by regional embedded capitals or factor endowment; and the drivers of regional productivity such as innovation, skills, and investment reveals the interrelated strand of regional competitiveness (Bristow, 2005).

Indeed as rightly stated by Bristow (2005) "regional competitiveness is itself complex" (p. 991). However the ability to increase output with a unit of input at a lower cost is a function of a dynamic process of progressive innovation required for regional growth (Kitson et al., 2004).

2.1.3 Global Food Network

Cities are currently networked in a space of flow, through enabling technologies and communication and on the factors of path dependence, specialisation, geographical and sectorial variation (Kitson et al., 2004). This suggests that the different services provided by cities link production and consumption locations in the global commodity (food) network (Castells, 1996, Brown, et al., 2010). This line of argument is complemented by Wall et al., (2011) where he states that global networks are disproportionately distributed based on factors of comparative and competitive advantages. These factors determine the variations in activities conducted between countries. He calls it the host and home determinants (Wall et al., 2011).

Brown et al., (2010) speaking on, "Toward a world-system integration" attempts to integrate the global commodity chain (GCC) and world systems of city networks (WCN) put forward by Sassen (1991) and Taylor (2001) respectively.

On one hand, Sassen (1991)) argues that, finance and knowledge flow plays an important role in global commodity chain for firms or organisations to continuously improve product value and market interconnectedness, hence their concentration in a few rich cities, which she called the global cities. On the other hand, Taylor (2001) argues that production processes and trade flow specifies the interconnected relations between cities and its intra-firms flow.

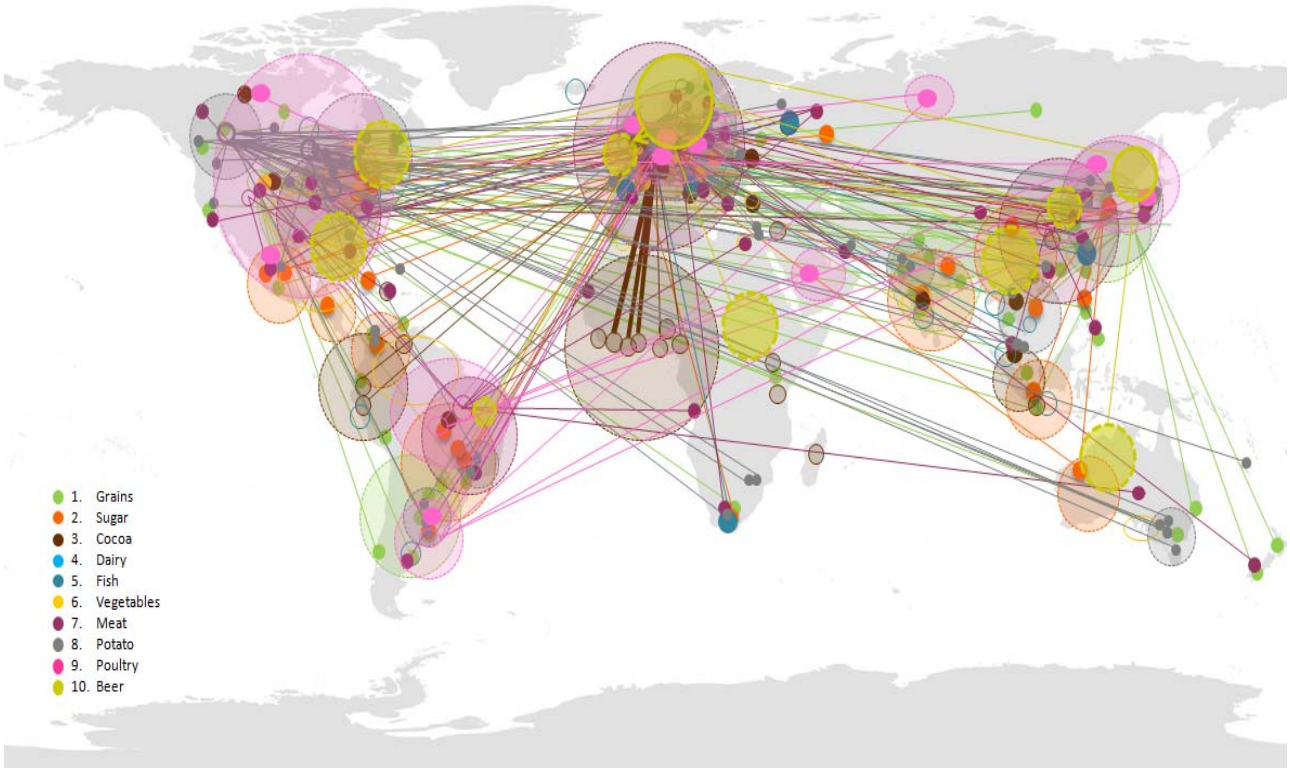
Furthermore, Brown et al., (2010), mentioned that knowledge, information, strategy, personnel and plans; flowing silently through electronic and humans across the world, break barriers that dominate cities and regions of the world. This he argued may de-lock opportunities for developing countries to upgrade their positions in specific global commodity (food) chains and network (Brown et al., 2010).

According to Brown et al., (2010); "*world cities form critical nodes in numberless commodity chains because it is from these cities, that core inputs required by all production chains are provided*" (Brown et al., 2010, p. 22).

Sassen (2010) in identifying the intersection of WCN and GCC, affirms that cities are production places for organisational commodities, and that, a focus of cities in global commodity (food) chain or network facilitate the capturing of a changing process, where there is a shift to a flexible and deregulated modes of operating.

For the global food system itself, firms and cities are prone to threats and opportunities that impact market equilibrium conditions. These changes necessitate the need for firms and cities to continuously upgrade (Brown et al., 2010).

Figure 3: Food investment network



Source: developed by UCR students from Orbis data (2002-2012)

The study by Wall et al., (2011) revealed that, at the varying scale of global networks; relationships into developing countries are related primarily in labour-intensive activities, natural resource and efficiency seeking. Their conclusion from the analysis of the geography of corporate city network, showed that physical and cultural distance still matters in global corporate network and that the core command of trade and global network control remains with the "happy few" of the developed nations (Wall et al., 2011).

2.1.4 Regional Resilience

Simmie and Martin (2009) and Pendall et al., (2010), have shared common understanding of the complex adaptive cycle as the key concept of regional resilience, despite the debate on the divergent perspective in the field of ecology, social and economics, particularly on notion of equilibrium analysis or adaptation systems.

Pendall et al., (2010) explored the applications of equilibrium state and adaptation cycles of regions in the context of resilience. Pendall et al., (2010) argue that, whilst ecologist views regions susceptibility and responses on the output to the state of normalcy or equilibrium, the economic and social ideology, view the process of reaching the state of normalcy as important and crucial to the outcome of addressing disturbances.

Pendall et al., (2010) further reiterated that, the nature of the challenge and the desired outcome of a region depend on either a short-term response to reach state of equilibrium; or on the other hand, the ability to change or retain structures and functions to a long term natural resting point.

Using the concept of Path lock-in, Pendall et al., (2010) concluded that, the difference in regional economic growth and resilience results from the path options available for responses. Additionally, Pendall et al., (2010) noted that, the existing knowledge within a complex social, institutional, economic and cultural context shapes the path breaking behaviours and changes.

Simmie and Martin, (2009) focussed their discussion on the adaptive cycle for long-term regional and urban economic development within an evolutionary perspective. Simmie and Martin, (2009) noted that;

"*Our starting position is a rejection of equilibrist approaches. This is because we think that the firms, organisations and institutions that comprise regional economies are continually changing and adapting to their economic environments. These changes are increasingly driven by the creation, acquisition and commercial exploitation of new knowledge. These processes are never in equilibrium".*

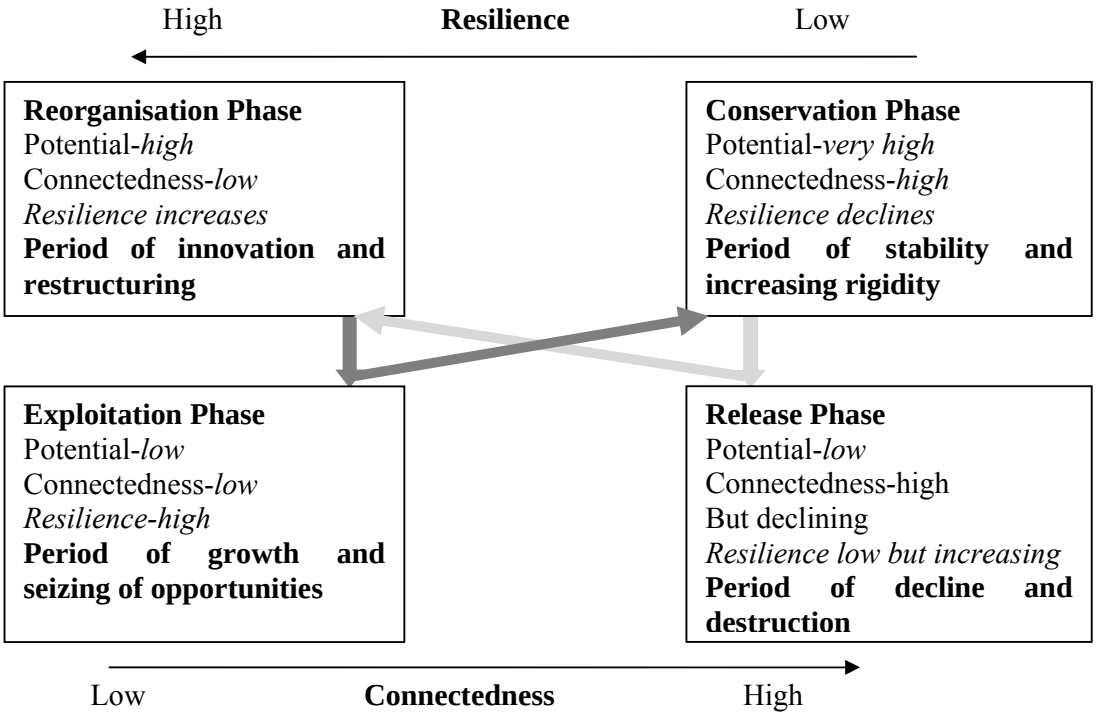
(Simmie and Martin, 2009, p. 27)

According to Simmie and Martin, (2009) the ability of a region to anticipate, prepare and respond to and recover from disturbances shows its resilience, however they subsequently argued that the adaptation cycle presents issues of potential and connectedness. Simmie and Martin, (2009) used the concept of path dependence of (Martin and Sunley, 2006) to argue that, regional path dependency and lock-in, constraint or enable adaptation processes.

Analysing the case of Cambridge and Swansea, the authors affirmed that internal sources of new knowledge combined with market driven entrepreneurial decisions are key determinants of resilience.

The case of Cambridge and Swansea used in their line of argument revealed that external shocks require the de-locking of an economy from a single path to a multi path. This, they stated necessitated institutions, enterprises and labour force to adapt to changing competitive technology and market pressures which confronts it rather than being locked into a stable technology (Simmie and Martin, 2009). The adaptation cycle discussed by Simmie and Martin, (2009) is presented in fig. 4 below:

Figure 4 Adaptive cycle (regional economic resilience)



Source: Simmie and Martin (2010), adapted from Holling and Gunderson (2002) and Pendall et al., (2010)

Release and Reorganisation phase: is the opening up of new potential types of activity and growth sources for exploitation.

Exploitation and Conservation phase: is the period of emergence, development and stability.

Connectedness: the interdependency among actors (trust, knowledge spill overs, local network, inputs, division of labour).

Potential: hardware, soft ware, institutions, skills, and competencies.

The de-locking process in the resilience concept combines the hard and soft networks used by Malecki (2002). He stated that a country could successfully de-lock, achieve resilience and become competitive, when it effectively combines at different geographical scales the gathering of knowledge via social interaction. This is what Malecki (2002) termed as a soft networks or in other words a soft ware. He further stated that this soft ware requires to a growing degree technological capacities either in industry, agriculture, high-tech sectors and public sector organisations.

The technological capabilities now demands hard ware and as such the decisions about the location of these hard networks (infrastructure) rest with the institutions both private and public in responding to issues of agglomeration economies and other very important demand of the business environment.

(Martin and Sunley, 2006, and Davies, 2011) advocate the importance of incorporating governmental and societal dimensions into the resilience approach. Davies (2011) analysed

the political decisions and institutional framework of ten (10) countries of the European region in the context of the 2008-2010 depression.

Using indicators of fiscal and austerity packages; she analysed the effect in three dimensions; long term adaptability, vulnerability to external shocks, and capacity to retain or change core functions. Her analysis revealed that for long term adaptability; "regional resilience is correlated with initial regional strength in some countries but with regional weakness in others" (Davies, 2011, p.379).

She further reiterated that manufacturing sector accounted for the resilience of most national economies in the region in 2009, whilst noting that fiscal stimulus and austerity packages have shown to have regional dimension in many countries but regional impact varies depending on the institutional and political dimensions (Davies, 2011).

She concluded that, despite the varying related issues in the resilience approach, which ranges from endogenous response and external disturbances, to political and institutional dimension, and finally, the role of the society and political actors in shaping adaptation capacities, it is necessary for government and society dimension to be incorporated into the resilience approach, since its analysis helps understand the evolution of regional economic inequalities (Davies, 2011).

2.1.4.1 The Importance of Regional Resilience and Food Security

Regional resilience and food security have received much attention within the United Nations, Food and Agriculture Organisation (FAO) and World Trade Organisations (WTO) especially after the 2008-2010 economic downturns. Simmie and Martin, 2009 and Davies, 2011, revealed that regional resilience is critical to understanding regional economic inequalities and the available lock in path that constraints or enables long-term adaptation.

Trade has been formed around regional blocks to boost regional integration, investment capital and long term economic security (Chortareas and Pelagidis, 2004). The European Union, Asia-Japan, and North America bloc and other institutions such as the African Unity (AU), ECOWAS, East African regional community and other regional blocks intend to boost, regional cooperation, however these regional blocs themselves do compete to attract capital, rising market share and better living conditions (Chortareas and Pelagidis, 2004).

The importance of regional and food security necessitated the recent article by Hoering (2013) on alternatives to food import dependency was sponsored and published within the European Union funded project on "Put MDG1 back on track: supporting small scale farmers, safety nets and stable markets to achieve food security" (Hoering, 2013, p. 1). This indicates the urgency of addressing food security issues.

Furthermore, "The Building Resilient Regions network, a MacArthur Foundation-sponsored research effort; examined the role of governance and other factors, in shaping regional outcomes, in the face of long term regional-scale economic and social challenges (http://brr.berkeley.edu)" (Pendall et al., 2008, p.71).

Finally, Olivier De Schutter (UN rappoteur on the right to food) argued for the development of domestic food production for a more self-sufficient and food secure agriculture (Hoering, 2013). In the above regard, the concept of regional resilience and food security explores the lock in conditions that shape a region's economic structure and the de- locking conditions

necessitated by external shocks (Simmie and Martin, 2009); this concept is applied to this research.

2.1.5 Food Security as Basis for Urban Competitiveness

Capital investment and knowledge management in agriculture and their related sectors are required for the enhancement of productivity, value addition and access to nutritious food. This is necessary in an attempt to achieve food security as defined by World Health Organisation (WHO) and FAO in 2009. This includes food availability (productivity), food access (economic and physical accessible), food utilisation (nutrition), and the stability in these three dimensions.

Sporleder and Moss, (2002) noted that continuous learning and skill acquisition is required in the food supply chain, from genetics to food service; (seedling supplies, equipment, transport, communication, irrigation, marketing, branding and packaging).

Furthermore as discussed by Huggins and Thompson (2013), the number of connections formed within local and non local regions results in knowledge capital required to increase return value for a city or region. The clustering of firms and the knowledge capital developed through continuous intra-firm interactions and research will ensure quality, safety, and reduction in production costs in the food supply chain, thereby enhancing food access, availability and utilisation.

It must be noted that achieving food security as a base for competitiveness does not only require capital investment and innovations in environmentally sound production and processing, but enhances localisation of entrepreneurship. Indeed as noted by Hoering (2013); local trading is enhanced and processing improved, thereby enhancing local entrepreneurship and reducing unemployment. Again local companies may move up the value chain to compete efficiently with foreign firms for shelves in supermarkets and shops (Hoering, 2013).

With the desire to achieve food security as a basis for competitiveness, various research and development is necessary to enhance information flow in forward and backward integration which efficiently uses technology and innovation to enhance product quality, (Sporleder and Moss, 2002). Hence, food security enhances a region's competitiveness through increased productivity and attractiveness.

2.1.6 Grain Optimisation and Resilience

Hoering (2013) stated that, improving domestic agriculture production is the rational response to reduce import dependence and improve food security. However Valdes and Foster (2012) state that "although for most countries self-sufficiency is neither feasible nor efficient, programmes to promote per-hectare productivity for smallholders (e.g., via extension and eased access to fertilizers and seeds) would boost the supply response to higher prices"(Valdes and Foster, 2012, p.1).

Valdes and Foster (2012) further stated that the unawareness of government to the food price surge resulted in adhoc measures to level consumer concerns. Hence the realisation of governments and institutions like the FAO and WTO on the urgency for future preparedness, and the social cost of neglecting the farm sectors (Valdes and Foster, 2012).

Various government programmes on productivity of small holder farmers and programmes of sustainable intensifications discussed by (Valdes and Foster, 2012 and Smith, 2013) are opportunities to be explored. Valdes and Foster (2012) noted that food importing countries are likely to remain exposed to world price shocks.

But why should African cities be grain insecure when there is a potential for grain optimisation to improve food security against shocks of import dependency in grain. Nigeria, Ghana, Tanzania, Uganda among other African countries has rolled out programmes for agriculture optimisation in rice and maize. However since wheat cultivation has been less of a farming tradition, it is less cultivated in Africa (Valdes and Foster, 2012).

For optimisation to improve food security, the assumption is that domestic policies are necessary to control food stock to reduce supply disruption when international food price volatility is experienced (Valdes and Foster, 2012).

Davies, (2011) mentioned that, the initial regional resilience impact, revealed a strong correlation in some national economies and weaker in others. The document for ECOWAS regional approaches to food security in Africa (p. 7) presented this evidently, stating that, ".....however, it is important to clarify that while more self-sufficient member states might be less active in pursuing regional opportunities, smaller and landlocked countries are more dependent on regional exchanges".

Furthermore Davies (2011) noted that, most of the fiscal and austerity packages were targeted more to the weaker economies of the region to improve their resilience.

Table 2 below shows the transition of developing economies in food and agricultural trade within the period; (1995-1999) and (2005-2009). The table shows the reduction of net agriculture export and net food import countries in sub Saharan Africa from 18 to 12 whilst net agriculture and food importers increased from 25 to 31 during the same period from 1999 to 2009.

As was discussed by Valdes and Foster, (2012) only fewer developing countries are net food exporters and could be able to benefit from agriculture price increase. The authors mentioned that though agriculture producers gain, the country as a whole also benefit from net food exports through foreign exchange earnings and export taxes. The authors further reiterated that security concerns arise when export country sets export restrictions and high exports taxes. To some extent these taxes and restrictions discourage export and increase world price in the global market.

The fact that sub Saharan and North Africa are recorded as net agriculture and food importers implies a rethink of policy measures to be redirected towards the utilisation of domestic agriculture production to improve security concerns and resilience to future shocks or short term interventions.

They argued that sometimes due to lack of resources and institutional capacity to respond to international price transmission to domestic markets, most government did nothing to insulate domestic market from price spikes. This Valdes and Foster, (2012) suggested could be for reasons of greater reliance on non tradable commodity such as cassava and yam.

Table 2: Net food and agricultural importers/exporters by regions

2005-2009					
Trade position					
Region	**Net ag and net food importing**	**Net ag exporting and net food importing**	**Net ag importing and net food exporting**	**Net ag and net food exporting**	**Total**
East Asia & Pacific	13	1	0	6	20
South Asia	6	1	0	1	8
Latina America & Caribbean	16	6	0	8	30
Europe & Central Asia	11	2	3	4	20
Middle East & North Africa	12	0	0	0	12
Sub-Saharan Africa	31	12	1	2	46
Total	89	22	4	21	136
1995-1999					
Trade position					
Region	**Net ag and net food importing**	**Net ag exporting and net food importing**	**Net ag importing and net food exporting**	**Net ag and net food exporting**	**Total**
East Asia & Pacific	12	2	0	6	20
South Asia	6	1	0	1	8
Latina America & Caribbean	11	9	1	9	30
Europe & Central Asia	9	5	2	4	20
Middle East & North Africa	11	1	0	0	12
Sub-Saharan Africa	25	18	0	3	46
Total	74	36	3	23	136

Source: Valdes and Foster, 2012: also cited from authors from FAOSTAT

As domestic production remains the alternative security measure against future market shocks, table 3 below combines from literature the various hard and soft ware's that could serve as comparative and competitive advantage to improve agriculture production and processes.

Malecki (2002) noted that the absorptive capacity of institutions and firms in production and processing is its ability to evaluate potential knowledge, assimilate and apply it. This requires networks of knowledge capital and social relationships both local and non-local.

The combination of the competitive and comparative indicators mentioned in table 3 represents what Malecki (2002) noted as the element of good people, good communications and good management of knowledge to build resilience against perturbations.

Table 3: Factor combination of comparative advantage and potential for competitive advantage in grain optimisation

External possibility	Comparative advantage	Potential comparative advantage	Potential competitive advantage
World input price →	Arable land	Access to capital	Strong relations between research/academia, government and enterprise
	Labour	Improve infrastructure inter- connectedness	Intrinsic motivation
	Existing Infrastructure	Extension services for per hectare productivity	Exchange networks
	Climate	Potential for grain production	Flexibility and competency of human resource

Source: Author (2014)

Valdes and foster, 2012 stated that the attempt by some net importers to reduce future risk by working towards grain self-sufficiency, emphasise the importance to mitigate against price volatility and export restrictions which consequently contributes to global food security.

2.1.7 Summary and lessons learnt from literature

From literature, it was noted that trade and globalisation have emerged as the driver of firm investments and country interactions. Most of the interactions revolve around technological districts, where the ability of labour to adapt, absorb, assimilate and innovate in the value chain of production is continually increasing and changing. The concepts revealed that trade is building up within regions and structural networks.

It was further revealed that the combination of a regions past trajectory and endogenous factors such as culture, trade and political regimes, institutional and technological structure, human capital and the physical and natural landscape are inputs that shapes the current output and market share in the global economy.

Consequently, the important nodes formed by a city or region in trade and production process specify the interconnectedness and relationships between the cities and its intra firm flows. It was realised that most of the relationships formed within and across regions are developed based on knowledge flow, access to financial and human capital and the flexibility of changing modes of operations. This was found to be critical to food network, as firms and cities within the global food network are prone to threats and opportunities that influence market equilibrium conditions.

The concept of regional lock in and the adaptation process to address shocks and to de-lock from locked in trajectories such as that of grain imports have revealed to a large extent, the importance of institutional ability to respond and adapt to changing trends. The technological capacity required by software demands the utilisation and location of hardware or infrastructure. This is necessary to enhance software use. The incorporation of institutions and the interdependency between actors based on trust and knowledge flow is found to be critical to the adaptation process.

Continuous learning and skills acquisition was found critical for the resilience or adaptation process. However it was found that in addition to the knowledge capital gained through network flow, local trading and processing are enhanced, thereby improving local entrepreneurship and reducing unemployment. Again local companies may move up the value chain to compete efficiently with foreign firms for shelves in supermarkets and shops. This consequently contributes to increase productivity and resistance to perturbations, which is an indicator of competitiveness and resilience.

The lessons learnt from literature provided the framework and methodology for addressing the questions posed in this research. The concept of lock-in and de-locking was found as the process that resulted to the lock-in trajectory to import dependency and as such the adaptation process to changing trends and future perturbations is an important tool that could be explored for resilience and grain optimisation for West Africa.

2.2 Conceptual Framework

The conceptual framework of the study uses the key concept of Regional lock-in and de-locking together with regional planning to define factor opportunities for domestic grain optimisation, and its implication for food security, consequently less import dependence and regional resilience.

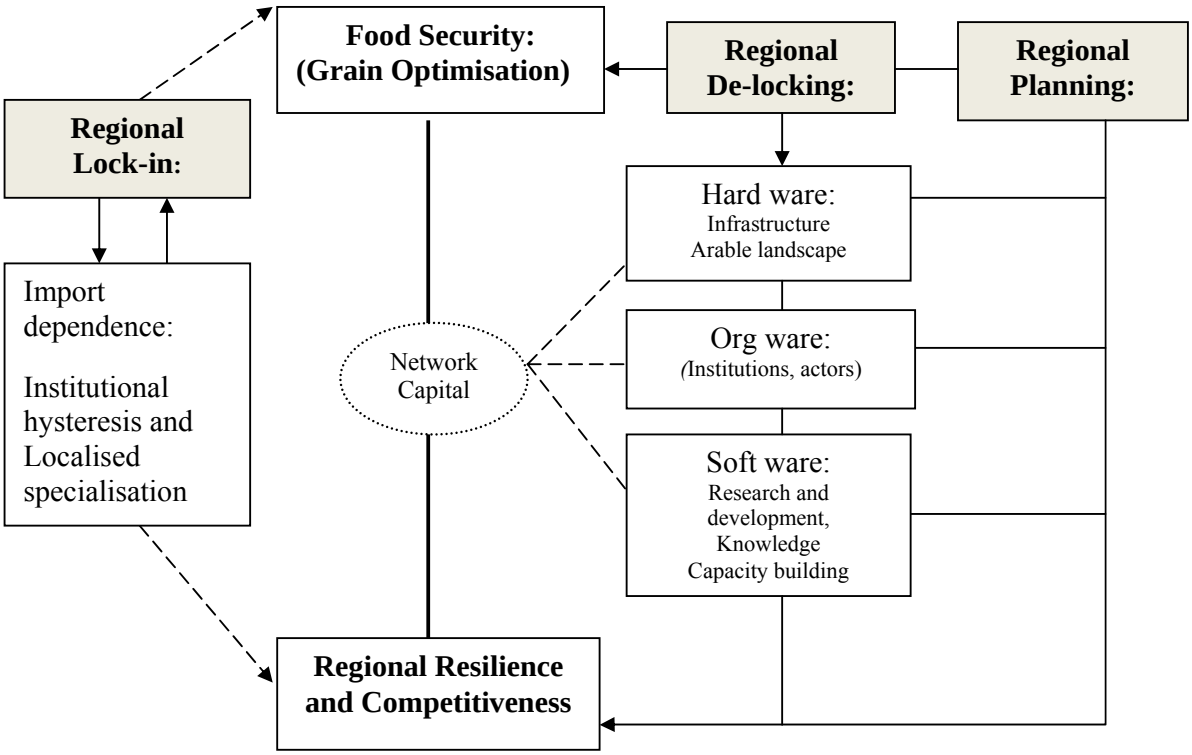
As was stated by (Scott and Storper, 2003, Kitson et al., 2004 and Storper, 2009) Trade; export and import of knowledge, capital, production resources and processes are important aspects for economic development and vital for the competitiveness and resilience of cities. Lessons from Huggins and Thompson (2013) in their literature on Network-based view of regional growth shows that due to regional inadequacies of endogenous factors such as stock of human capital and production inputs, alliances are formed between actors and agencies for increasing economic return.

They argued that network capital is a key relational asset central to trade and alliance. It is essential to renew knowledge stock and promote technological dynamism through networking, in anticipation of external disruption and misalignment to endogenous equilibrium; which may result in decreasing economic return effects to processes that previously generated increasing economic returns.

Lessons from Malecki (2002), Martin and Sunley, (2006), (Simmie and Martin, 2009), Valdes and Foster, (2012) and Huggins and Thompson (2013) are applied to regional de-locking. It combines the demand for hardware and the ability of institutions and its actors to utilise knowledge inputs required for regional adaptation process. The study utilise their concepts as the tool to lock out West Africa grain imports dependency to improve its resilience in grain security.

In this context, it is expected that the adaptive and absorptive capability of institutions to lock out institutional hysteresis in grain imports will enable institutions to anticipate, evolve and adapt to technological change and market decline. In effect the region's economic growth and resilience over time in food security is envisaged.

Figure 5: Conceptual framework



Source: Author, (2014)

As presented in the conceptual framework, factors existing in a region over time and space have an effect on food security, city or regions competitiveness and resilience. In the context of food security for Africa, the import dependence determined by the: institutional hysteresis (lag of response to cheap food access, substituted for domestic production), socio-cultural structure and localised specialisation of subsistence cultivation, coupled with technological stagnation have impacted its food security, competitiveness and resilience. Hence, regional lock-in.

The potential of network capital which is central to food security and competitiveness of the region is based on the hypothesis that domestic optimisation would have positive impact on food security and resilience. However, this will depend to a large extent on the dynamic interaction between hardware (infrastructure interrelatedness), orgware (institutions and

actors) and software (research and development) to generate an increasing or steady economic return effect. Hence, regional de-locking.

Combining regional de-locking with regional planning, the focus on metropolitan food cluster (MFC) is required. From Pete Smeet (2014, Wageningen University) definition, this is a spatial network of physical hub that builds knowledge and innovation. In integrated planning, the connection of the periphery with the urban core through the location of agro parks, rural transformation centres and consolidation centres, will enhance the optimisation of grains and it associated services in relation to the supply of market needs and other competitor quality. Hence, leading to domestic optimisation and ultimately regional resilience.

Chapter 3: Research Design and Methods

3.1 Introduction

This chapter focuses on a step-by-step approach undertaken towards the research design, data collection and data analysis methods. The selected research design examines how grain import dependency relates to food security. Furthermore, the chapter developed a framework for data collection and analysis which is logically structured to facilitate the collection of appropriate data; based on identified indicators from previous chapters.

3.1.1 Revised Research Questions

Lessons learnt from the literature review have enabled the revision of the research questions. the endogenous factor available in a region and the absorptive capability of knowledge through social interactions and networks have enabled the research to focus on production and location factors significant to regional economic inequalities and resilience, over time and space.

According to theories, regional resilience, which invariably comprise, the concept of path lock-in and de-locking are predominantly dependent on the ability of institutions and actors to adapt and access knowledge and capital through social relationships and interactions. Other factors for adapting to technological cycles and market trends include the quality of infrastructure, technical skills, cognitive ability and flexibility of human resources available. These factors necessitate localised learning, exploring new networks and potentials for developing a better understanding of what makes a region more or less attractive, vulnerable and resilience**.**

The main research question stated for the study is:
To what extent does grain import dependency relate to food security for the West African region?

The revised sub research questions are:

- What is the growth of imports over time for wheat, rice and maize in the world?
- Which countries have higher import dependency in West Africa and which countries supply the West African region?
- What production and location factors (orgware; software; hardware) determine grain import dependency for West Africa?
- What production and location factors need to be improved to make countries less dependent and optimise grain production for food security in the West African region?

3.1.2 Operationalization: Variables, Indicators

The indicators selected below are based on the variables defined from the conceptual framework. In the operationalization of the research conceptual framework; variables and indicators have been categorized under dependent (Y-variable) and independent(X-variable).

On one hand, the Y-variables of the study are the Value and volume of import of wheat, rice and maize. This data is derived from the database of FAO.

On the other hand the X-variables are (a) production factors; and (b) location factors. The sub variables under the location factors have been categorised into hard ware (infrastructure), orgware (institutional ability) and software (knowledge capital). This classification is based on the interconnectedness between these elements as described in literature is critical for the improvement of resilience to changing market trends.

Production data from FAO

Dependent variables

The Value, volume and production quantity of maize, rice and wheat import derived from faostat are time series and cross sectional data for the period 2002-2011. This data describes the production quantities and dollar value of these grains.

It is presented as the outcome (dependent) data for food security. Data gathered by FAO on these indicators are based on data availability and expert judgment. The data collected on production, import and export is to enable the comparison across regions and over time.

Explanatory variables

The other indicators such as value of agriculture input, Physical condition (arable land), producer price index and technological investment are determinant (independent) indicators of food insecurity. These indicators are either static or dynamic and their effects are structural conditions that may influence food security in the absence of policy interventions and emergency response.

The indicators mentioned as outcome and determinant indicators are a combination of existing endogenous factors in a region and changing market trends. These indicators are determinants of production outcome which supports the theory by Sassen (2010) that cities are production places for organisational commodities and Brown et al., (2010) who states that cities provide the core inputs required by all production chains.

Location data from GCI

The global competitive index released by the World Economic Forum 2013-2014 provides the set of indicators required for sustaining growth and building resilience. These indicators are categorised under 12 pillars of competitiveness. These pillars are a set of institutions, policies and factors that determine a country's productivity level. The rate of return obtained on an investment is determined by the productivity level.

Explanatory variables

The location indicators from GCI are determinants of growth and productivity and as such are dynamic in nature. In economic literature, the comparative advantage theories emphasise investment in physical capital and infrastructure.

However in recent decades, the concept of competitive advantage advocates for investment in education and training, technology improvement, labour and financial market efficiency, good governance (institutional ability) and macroeconomic stability as important pillars for productivity growth and building resilience. Various sub indicators have been developed to drive these broad pillars.

In accordance with literature by Taylor (2001), Malecki (2002), Sassen (2010) and others, the indicators of technology improvement provides the knowledge base upon which physical capital and infrastructure can produce the required rate of return on investment for the promotion of regional growth.

In this regard the indicators on Level of education, Rate of R&D investment, Available technical know-how and skill and Flexibility to absorb technology were collected. Other indicators include subsidies and taxes, domestic market access, capacity building and training, financing technology access and access to finance.

These indicators selected have been categorised under infrastructure, knowledge capital and role of institutions to facilitate increasing productivity. Several authors and FAO reports from literature reviewed in chapter two have stressed the importance of these indicators to food security.

Table 4 below summarise from theory the concepts and indicators operationalized and table 5 provides a summary of variables and indicators described above.

Table 4: Operationalization of concepts

Analysis	Research Question	Concept	Variables	Indicators
Descriptive statistics	What is the growth of import overtime for wheat, rice and maize in the world?	Global Food Network Food security	Accessibility production capital	Availability/ Quality of Road, airport, sea/inland port, Railroad , Electricity supply, internet network Value of agriculture inputs Physical condition (arable land) Technological investment
	Which countries have higher import dependency in West Africa and who are the source of supply for West Africa region?	Global food network Food security	Locked trajectories (Institutional hysteresis)	Response to input and % grain price increase Type of intervention in agriculture sector -subsidies and taxes -domestic market access -capacity building and training -financing technology access -access to finance
Explanatory	What production and location factors (orgware; software; hardware) determine grain import dependency for West Africa?	Regional resilience Competitiveness	De-locking potential Networks Knowledge capital	Level of education Rate of R&D investment Available technical know-how and skill Flexibility to absorb technology Rate of utilisation of new technology
	What production and location factors need to be improved to make countries less dependent and optimise grain production for food security in the West Africa region?	Regional resilience competitiveness	Adaptation ability	

Source: Author, (2014)

Data Type and Description

Table 5: Variables and Indicators

Name (variable)	Description of indicators	Source of Information	Unit	Data type (scale)
Y-variable: Import data				
FAO dataset	Production/import/export year	FAO	-	interval
	Country/region type	FAO	-	nominal
	Grain type		-	nominal
	Production volume (MT)	‘’	MT	interval
	Yield per hectare	‘’	-	ratio
	Import volume	‘’	MT	ratio
	Import value	‘’	$	ratio
	Export volume	‘’	MT	ratio
	Export value	‘’	$	ratio
	Consumption volume	‘’	TT	ratio
	Consumption value	‘’	$	ratio
	Country code	‘’	-	dummy
X-variable: Production data for grain optimisation: FAO dataset				
Prices				
Nutrient use	Nutrient use per hectare	FAO	$	ratio
Tractor	average Price of tractor per year	‘’	$	ratio
Technology (irrigated area)	percentage of irrigated area of total agriculture area	FAO	%	ratio
X-variable: Location data GCI dataset:				
Infrastructure: proximity/accessibility				
Accessibility by road	quality of road	GCI/GCR	-	Interval
	proximity of road to domestic market			
Sea/inland port	quality of sea/inland port	GCI/GCR	-	interval
Railroad	quality of railroad	‘’	-	interval
Electricity		‘’	-	interval
accessibility and supply	quality of electricity supply	‘’	%	interval
telecommunication	mobile telephone subscriptions/100 pop			ratio
Institutional ability				
Responses to price	input and grain price increase	FAO	-	interval
			-	interval
Risk management ability	reliance on professional management	GCI/GCR	-	
	agriculture policy cost		-	ratio
Domestic market		GCI/GCR		

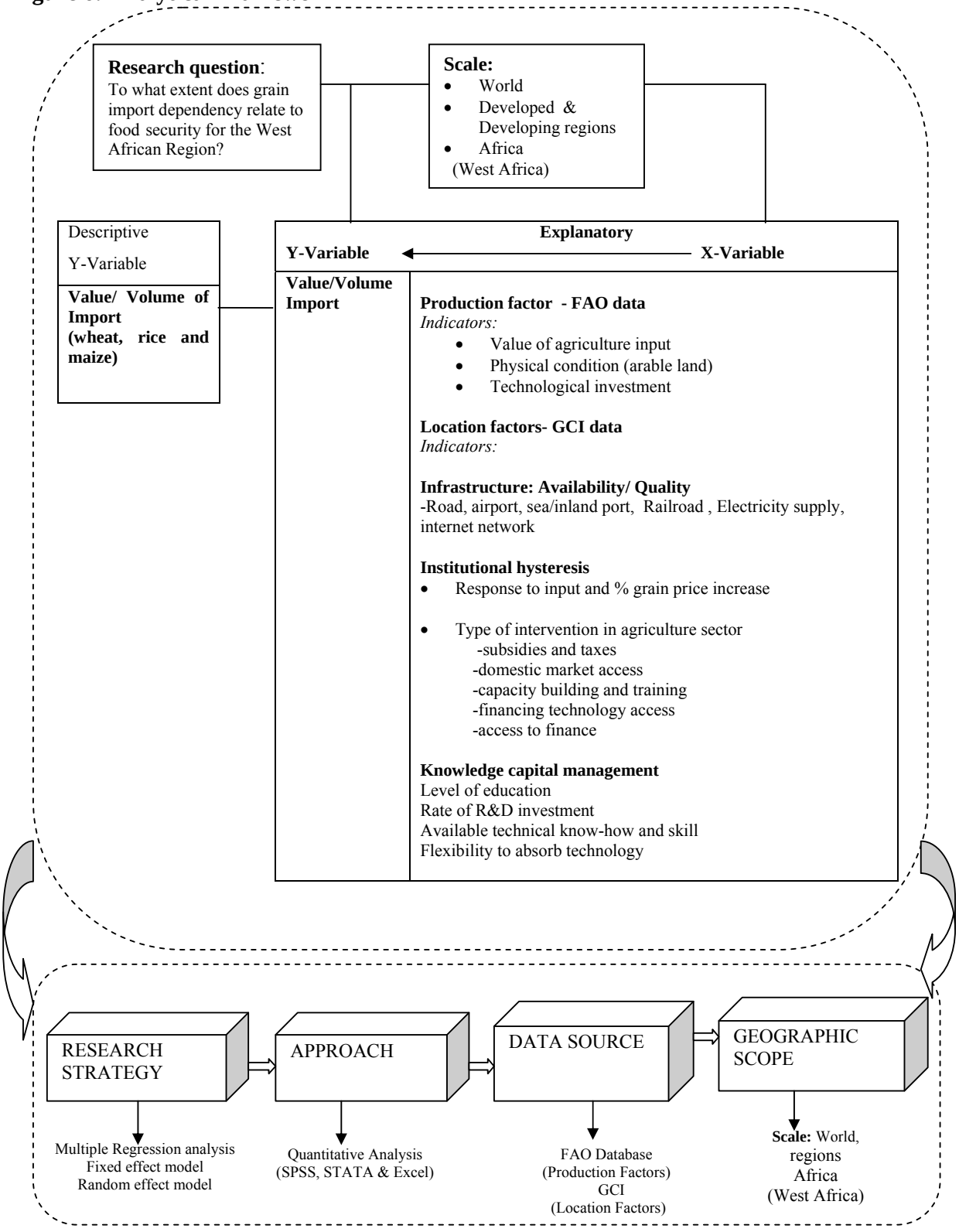
dominance	domestic market dominance			
	intensity of local competition		-	
Trustworthiness and confidence		GCI/GCR		ratio
	financing technology access			
	ease of access to finance		-	
Capacity building and training		GCI/GCR		ratio
	availability of specialized research and training services	‘’		
	extent of staff training			
Knowledge capital				
Available technical know-how and skill	availability of scientist and engineers	GCI/GCR ‘’	- %	Interval ratio
	% of individuals using internet			
Education level		GCI/GCR	%	ratio
	% of primary education enrolment	‘’		‘’
	quality of educational system	GCI/GCR		interval
R&D investment	quality of management schools	‘’	-	‘’
	quality of scientific research	GCI/GCR		interval
Technological Flexibility	institution		-	
	university-industry collaboration in R&D			
	firm level technology absorption			

Source: Author, (2014)

3.1.3 Analytical Framework

For easy identification of the step by step approach to the selected research strategy, the following techniques and data analysis methods were employed to meet the objectives of the research study. A visual conceptualisation is presented in figure 6 below:

Figure 6: Analytical Framework



Source: Author, (2014)

3.2 Unit of Analysis

The research analysed grain imports at different geographical scale from global and regional perspective. It further focused on West Africa region to investigate the vulnerability of the region for its dependence on wheat, rice and maize imports to feed its increasing population.

"The current increasing demand of cereal for non-food use in the bio-based economy, combined with unfavourable weather episodes has presented current challenges of increase international food prices; thus placing additional burden on poor food consumers in these regions"(faostat, 2013 p. 126).

The research further analysed the source countries and ties for West Africa for its import of wheat, rice and maize. The result of the analysis provides an understanding of regions network ties, thereby providing an insight into the factors that enhances the optimisation potential of those countries.

In addition, a detailed analysis of location and production factors is undertaken at the different regional levels; from which lessons learnt are applied to West Africa's regional resilience in grain production.

3.3 Data collection

Secondary data sources have been used for the study. The required data was gathered from professional database sources with proven records of pre-established validity and reliability.

- Data from the two secondary sources are: FAO and Global Competitiveness Index (GCI). The FAO database was used to analyse the growth in production, consumption and price of wheat, rice and maize over time.

  On the other hand, agriculture production factors from FAO database and location factors from GCI database has been analysed to understand the significance of the various factors to the inequality in the regional production output.

- A quantitative approach has been used to analyze production and consumption growth of grains over time. This approach further examined the extent to which the production and location factors explained the growth of grain production and consumption in terms of value or volume.

  Hence explaining to what extent the independent variables relate and influence the dependent variable in achieving resilience for regional food security. The data analysis used the deterministic model (pooled OLS), fixed and random effect model which is explained in section 3.4 below

3.4 Strategy and Approach

The research strategy used a descriptive and an explanatory approach. The descriptive session analysed the growth of import, export and production and countries with high import dependency in West Africa and their network ties. The analysis identified the rank of the 40 biggest import and export countries for wheat, rice and maize. This was done to identity the supply and demand destination of the grains, and the factors explaining the ranks.

The explanatory research employed a combination of deterministic (pooled OLS), probabilistic (random effect model) and fixed effect model. The data analysed is a panel data which describes time series and cross sections.

The data used observed behaviour of countries in import, export and production across the period 2002-2011/2012. The pooled OLS model ignored the analysis of the time variations and cross sections. It therefore, ignored certain critical events that influence the outcome variable. The fixed and random effect model considers the time series and cross sections, thereby controlling the heterogeneity among predictor variables and countries. Consequently the random and fixed effect models were tested using the Hausman test to identify the model suitable for the interpretation of results.

The Hausman test is modelled on two hypotheses.

H_0 : The unique errors ($u_{i)}$ has no correlation with the regressor or predictor variable (choose Random effect)

H_1: The unique errors ($u_{i)}$ has a correlation with the regressor or predictor variable (choose Fixed effect)

The error term (u_i) is the unique characteristics which has an influence on the predictor variable in predicting the outcome of the dependent variable (institutional culture, political regime and a country's social policy).

The fixed effect model controls the time invariant differences between entity and countries and assumes it constant for all entity; however the random effect includes such time invariant characteristics such as gender, age and religion in the model.

The results of the Hausman test revealed $p<0.05$, the results obtained resulted to the use of the fixed effect model for result interpretation.

This fixed effect model was then modelled to identify the significant effect of the production and location factors that best explains the outcome variable of import, production and export which has effect on food security and resilience.

The formula for fixed effect model is stated below

$Yit = \beta 1 Xit + \alpha i + uit$
αi (i=1….n) is the unknown intercept for each entity (n entity-specific intercepts).
– Yit is the dependent variable (DV) where i = entity and t = time.
– Xit represents one independent variable (IV),
– $\beta 1$ is the coefficient for that IV,
– $u$it is the error term

3.6 Geographic Scope and Selection

The geographical scope of the research focused on the West Africa region. This region was selected based on the growing demand for grains and its relative dependence on import to satisfy demand.

The research studied to what extent different countries in developing regions compare in relation to production and location factors and how the difference in these factors influence their import demand and subsequently on regional output.

It further examined how these differences influence regional production output and resilience in rice; wheat and maize and what policy implications can be derived for the West African region to reduce its vulnerability on grain imports to ensure regional food security.

3.7 Data Analysis Techniques

Data analysis is categorised into descriptive and explanatory part. Each category has specific research questions and methodology.

Part I. Descriptive

The descriptive analysis focused on import growth, rank of major import countries and West Africa import activities in relation to source countries and ties.

What is the growth of import of wheat, rice and maize over time?

Subject	Import growth over time		
Result	Overview of which grain types are growing or declining in import value/volume		
Data used	*Method*	*software*	*outcome*
FAOSTAT	Trend analysis	Excel	Growth/decline of import value

The import growth for wheat, rice and maize over the years 2002-2011 are analysed. Line graphs in excel are used. The percentage change over the years 2002-2011 for the grains has been analysed using excel to see the extent of variance in the growth of import over time. The line graphs were used to show the growth and decline in the import volume/value.

Which countries are the major importers and exporters in wheat, rice and maize over time?

Subject	Ranking of major import and export countries		
Result	Source countries for grain import and major import countries		
subject	*Method*	*software*	*outcome*
FAOSTAT	Quartile and percentile analysis	Excel	Major importers and exporters

The aggregate sum and average of the individual countries for the period 2002-2011/2012 is sorted from largest to the smallest. One third of the total observation which is made up of 50 individual countries was selected along with their various observations for the period under review. This is then analysed with the quartile and percentile formula in excel. This analysis uses the quartile formula in excel to calculate the rank of the major importers and exporters at the 50^{th} percentile in the years 2002-2011/2012.

The analysis indicates the share of value and volume of major import and export countries related to wheat, rice and maize. The percentile value of the countries are categorised in the range of the 70th, 50th and below 50th percentile for 40 major export and import countries. This analysis is carried out to ensure a representation of countries over the period under review**.**

Which countries have higher import dependency in West Africa and which countries are the sources of supply for West African region?

Subject	Overview of West Africa's grain importers. Source countries and ties		
Result	Source ties and West Africa import dependent countries		
subject	*Method*	*software*	*outcome*
FAOSTAT	Core and periphery analysis	Excel/Ucinet	Linkage structure

This analysis gives an overview of grain import countries of West Africa and its country to country network with the source and destination of wheat, rice and maize.

Part II. Explanatory

The explanatory analysis focused on which location and production factors are determinants of a countries relative dependency on grain imports. On the level of West African region, a further analysis has been made using the fixed and random effect model to examine the changes in the dependent variable, when the heterogeneity of country characteristics is assumed.

What production and location factors (orgware; software; hardware) determine grain import dependency for West Africa?

Subject	Causality between production and location factors and grain optimisation for the West African region		
Result	Overview of production and location indicators as determinant for grain optimisation and reduction in import dependency for West Africa region		
subject	*method*	*software*	*outcome*
FAOSTAT	Deterministic model (Pooled OLS) Fixed effect model Random effect model	stata	Causality

What production and location factors need to be improved to make countries less dependent and optimise grain production for food security in the West African region?

Subject	Indicators for grain optimisation for the West African region		
Result	Indicators for grain optimisation and reduction in import dependency for West Africa region		
subject	*method*	*software*	*outcome*
FAOSTAT	Deterministic model (Pooled OLS) Fixed effect model Random effect model	stata	optimisation

Stata was used to model location and production indicators against the dependent variable of import, export and production. The significant indicators for the fixed effect model were interpreted as the results of the analysis.

3.8 Validity and Reliability

McGoey et al., (2010) refers to reliability as a research that is confident, that scores obtained are consistent over time and across different conditions or when different set of indicators are tested under conditions that vary in some other way. On the other hand, validity is explained as measuring exactly what the research intended to measure and how well the data collection instrument measured the scored acquired with minimal error (McGoey et al., 2010).

To establish the validity and reliability of this study, a triangulation methodology was used. The results obtained from the multiple linear regression analysis and the fixed and random effect model were triangulated with findings in theories and other similar studies related to the subject.

Indicators from theories, pooled OLS, Fixed and Random effect model were used for data analysis. Secondary source data from FAO and GCI were also used both as descriptive and explanatory statistics. The results have proven to be functional and consistent to varying and similar scientific research.

The hypothesis of fixed and random effect model was tested using the Hausman test. The results showed that fixed effect model was suitable for the interpretation of the results.

- In the modelling of the indicators, the multiple collinearity checks was undertaken to eliminate indicators with Vector Inflator Factor with results > 10. Overall infrastructure improvement was eliminated from the pillar under infrastructure.

Chapter 4: Research Findings

The chapter presents an overview of grain production, import and export at different scales. The world, developed and developing regions, including Africa and West Africa was analysed within the context of food security (accessibility) and regional resilience. The chapter attempts to identify the production and location factors which explain the vulnerability and resilience of region/country to optimize grain production and improve resilience.

4.1 Descriptive analysis

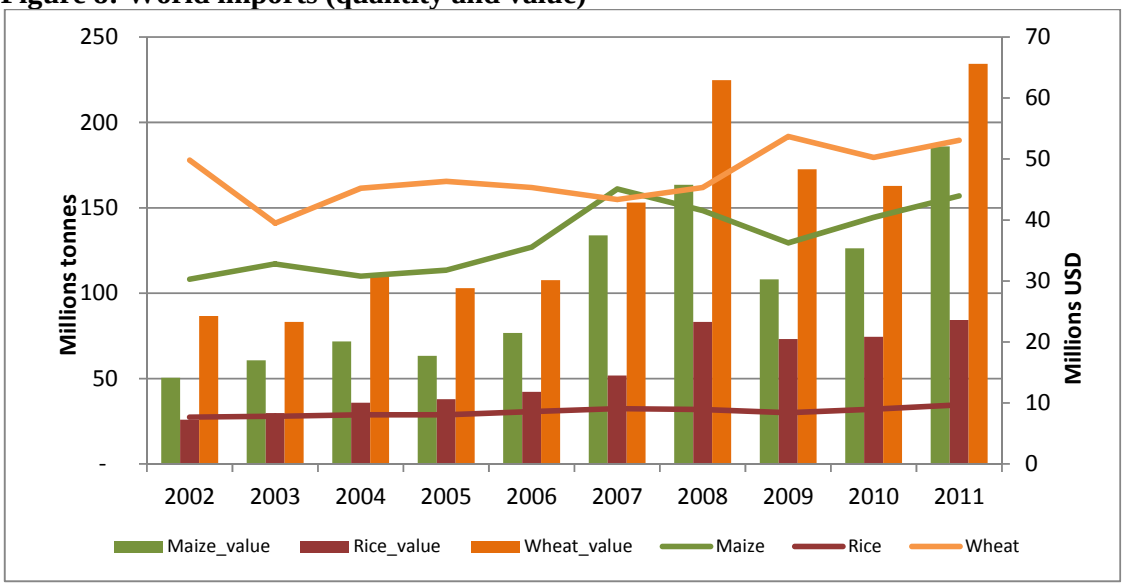
This section describes the growth of imports, exports and production over a ten-year period (2002-2011) for maize, rice and wheat. It further describes the rank of the major export and import countries and regions. The section also shows the source countries and their network strength the West African region in grain imports. The study further reveals West Africa's import dependent countries.

4.1.1 What is the growth of world imports of maize, rice and wheat over time?

A total of 165 countries for production, 191 countries for import and 161 countries for export were analysed for maize. Rice analysis involved 118 production countries, 200 import countries and 176 export countries whilst wheat analysis involved 125 production countries, 188 import countries and 151 export countries (Data source, FAO dataset 2002-2011).

From the analysis below, wheat shows up as an important staple in the world food basket, compared to maize and rice. The periods, 2003, 2007 and 2009 showed that wheat and maize are in competition in the global food basket, a sharp decrease in wheat imports resulted in an increase for maize imports.

Figure 8: World imports (quantity and value)



Source: Author, (2014) based on Faostat, 2013

The steady increase in maize imports from 2004-2006, coupled with its sharp increase in 2007, is attributed to its competition as food and fuel. The effects of the steady increase affirms Godfray et al., (2010) statement that the Patterns in global food prices are indicators of trends in the availability of food, at least for those who can afford it.

The implication is that as grain price increase due to its high demand and consequent shortage in supply, the impact on the availability of food and the economic access to it is negatively affected. This phenomenon corresponds to the period of global fuel crises during which maize was being used as substitute for petroleum. Maize export quantities fluctuated within that period to ensure that domestic food demand and self sufficiency were ensured in export countries, whilst ensuring enough stock for the future.

Table 6: Percentage change in import value and quantity

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Maize import quantity	2%	-8%	7%	9%	12%	-4%	-3%	7%	0%
Maize import value	14%	16%	-7%	18%	54%	29%	-28%	14%	39%
Rice import quantity	6%	8%	1%	9%	13%	14%	-9%	0%	15%
Rice import value	29%	10%	-8%	12%	34%	52%	-6%	-13%	25%
Wheat import quantity	-8%	5%	3%	6%	-2%	3%	14%	-2%	3%
Wheat import value	5%	21%	-5%	15%	41%	50%	-26%	-2%	41%

Source: author (2014) calculated based on the Faostat (2013)

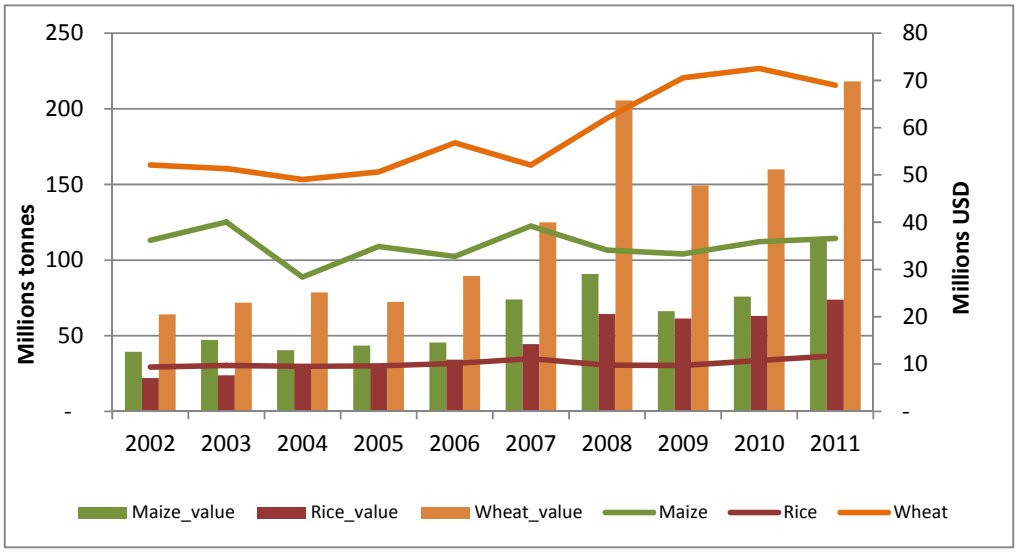
Speculative high price resulted in the reduction of supply quantity by major export countries such as the United States of America and Argentina. This was done for purposes of ensuring future domestic stock.

The import value of all three grains has been increasing steadily, intersperse with some level of reduction, it eventually picked up sharply in 2004, 2007 and 2008. The higher value for the grains in 2008 resulted in a reduction in import quantities of 2008 and 2009 for maize and rice.

Furthermore, results shows that export quantities reduced in the same period (2008 and 2009) for maize by 7% and 1% and for rice by 12 % in 2009. Whilst on the contrary quantities for import and export increased in wheat within the same period.

As noted by Tadesse et al. (2013) speculative high price and price dynamism triggers endogenous shock measures such as restrictive trade policies, speculative activities resulting to reduction of supplies, in order to take advantage of increase price (driven by price expectations),and the decline in global food stocks. This measure explains the reduction of supplies from US and Argentina. It also implies a rethink of imports as a compliment to domestic supplies by net food import countries.

Figure 9: World exports (quantity and value)



Source: author (2014) calculated based on the Faostat (2013)

Generally rice value for imports and exports have been steadily increasing at a lower rate over the review period except in 2007 and 2008; when it increased with a higher margin, due to international price increases for grains generally. This situation led to the rise of imports and export values against the reduced margin of import and export quantities in 2009 and 2010 for rice.

With major supply and demand concentrated in Asia and Africa, coupled with a marginal increase in population for Asia and increasing population growth in Africa, imports and export volumes continue to increase but at a steady rate. Population increase and change in preference for consumption towards rice by some regions of the world such as Africa, implies that import and export quantities will continue to increase for rice (Demont, 2013)

Wheat, maize and rice import and export values continued to rise in 2010 and 2011. As values remained high, net import values continued relatively to rise, thereby widening the food trade deficit. The trickling down of world grain price to domestic grain price, affected the economic access of households and urban poor, especially in developing regions of Africa (Tadesse et al., 2013).

Table 7: Percentage change in export value and quantity

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Maize export quantity	4%	-9%	9%	6%	15%	-7%	-1%	7%	2%
Maize export value	13%	5%	-4%	18%	57%	30%	-26%	14%	48%
Rice export quantity	2%	-5%	15%	-3%	6%	15%	-12%	2%	14%
Rice export value	18%	3%	5%	1%	22%	54%	-10%	-16%	21%
Wheat export quantity	-9%	9%	1%	5%	-1%	5%	12%	-1%	2%
Wheat export value	4%	21%	-9%	17%	48%	45%	-30%	5%	44%

Source: author (2014) calculated based on the Faostat (2013)

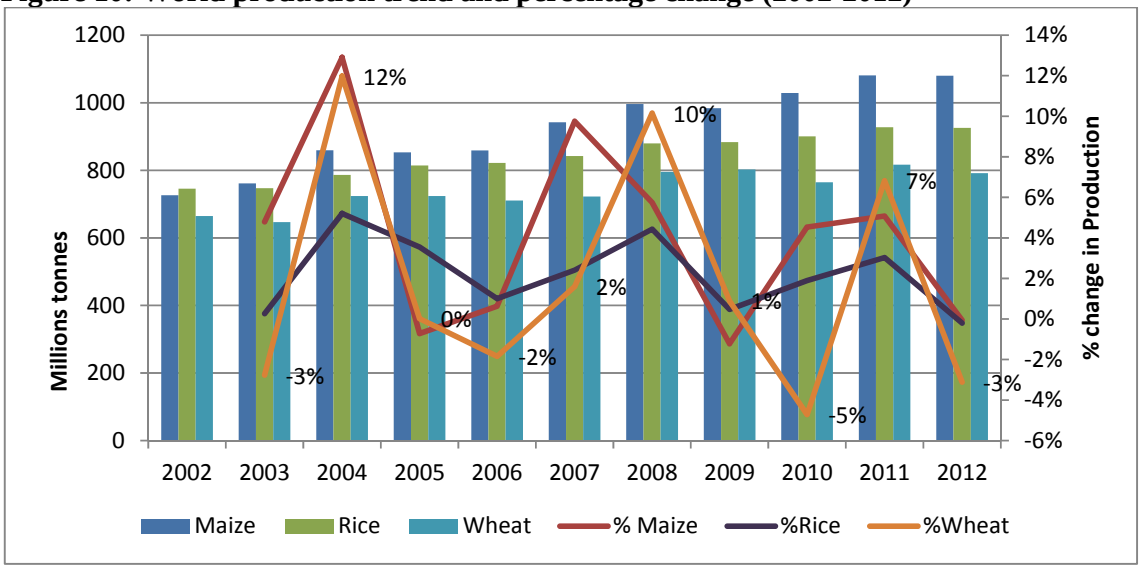
Export quantities reduced for maize and rice in 2004 by 9% and 5% respectively. Poor harvest resulting from weather related conditions and the strong domestic demand for ethanol and other feed industries by the major export countries of the United States, Argentina, Brazil and Ukraine during the 2004 period can explain the above reduction rates for maize.

The reduction in export quantities in 2009 for maize, rice and wheat can be explained by the food crises in 2008 and its lingering effect in 2009 as and the subsequent policy measures undertaken by major export countries (Tadesse et al., 2013). This was done to increase the domestic buffer of export countries to cushion themselves against food shortages and higher prices.

Tadesse et al., (2013) noted that low US stock-to use-ratios is an important factor in increased price volatility.

2010 and 2011 export trends are showing, a world recovering from the 2008 and 2009 crises but recovery is fragile and slow which reflected the percentage growth, however, in 2011, wheat export quantity recorded a drop in export rate by 1%, which could be attributed to the low international demand for wheat as was reported in FAO report and other journals.

Figure 10: World production trend and percentage change (2002-2012)



Source: author (2014) calculated based on the Faostat (2013)

Maize has the highest aggregate volume, followed by rice and lastly by wheat. Countries involved in maize production are more than rice and wheat producers, with maize production evenly spread across the world. Generally higher production volumes for the grains are concentrated in the hands of a few countries in the temperate regions compared to countries in the tropical regions ((FAO, 2013).

Aggregate production volumes continue to increase at a steady rate for the grains; with the years 2003, 2006, 2010 and 2012 recording a slight reduction in volumes for wheat. 2005 and 2009 also recorded a slight reduction for maize. However, rice production volumes have maintained a steady increase but at a lower rate over the review period excluding the year 2012, when it reduced marginally in aggregate volume.

The period between 2004 and 2011 recorded a higher percentage increase in volume for all grains than other years under review. Other preceding and subsequent years recorded fluctuations in percentage volume, but with an increase in aggregate volume.

Weather related changes such as drought and flood, technology investment to increase yield, post harvest losses and policy responses in terms of agriculture subsidies, agriculture input prices and market prices for food crops are reasons that can be attributed to such variability in seasonal production volumes.

Lessons learnt

- Wheat imports and exports quantities have increased over the period, compared to maize and rice. However maize has the highest aggregate production volume due to the evenly spread cultivation.

- Despite the importance of wheat in the world food basket, Maize export is significantly influenced by speculative price hikes. This resulted to the reduction of export quantity by 9%, 7% and 1% in 2004, 2008 and 2009 which were also periods of oil shortages. This result was confirmed by (Godfray et al., (2010), Tadesse et al., 2013). Tadesse et al., (2013) estimated using the fixed effect model to affirm that high maize price is volatile to oil crisis on the world market.

- The effect of export reduction resulted to import value increased by 16%, 54% and 29% in 2004 and 2007 and 2008, and a reduction by 28% in 2009, when there was some crises recovery. The results is further validated by Tadesse et al., affirmation of oil price spikes effects and Godfray et al., (2010) statement on demand driven effect for bio fuels production and domestic consumption.

The implication is that net grain importers will be vulnerable to price effects on their budget deficits and the demand effects on the middle and low income groups. As already stated, Tadesse et al. (2013) affirmation that speculative high price and price dynamism triggers endogenous shock measures such as restrictive trade policies, speculative activities which results to reduction of supplies to take advantage of increase price (driven by price expectations),and the decline in global food stocks will have a consequential negative effect on net importers.

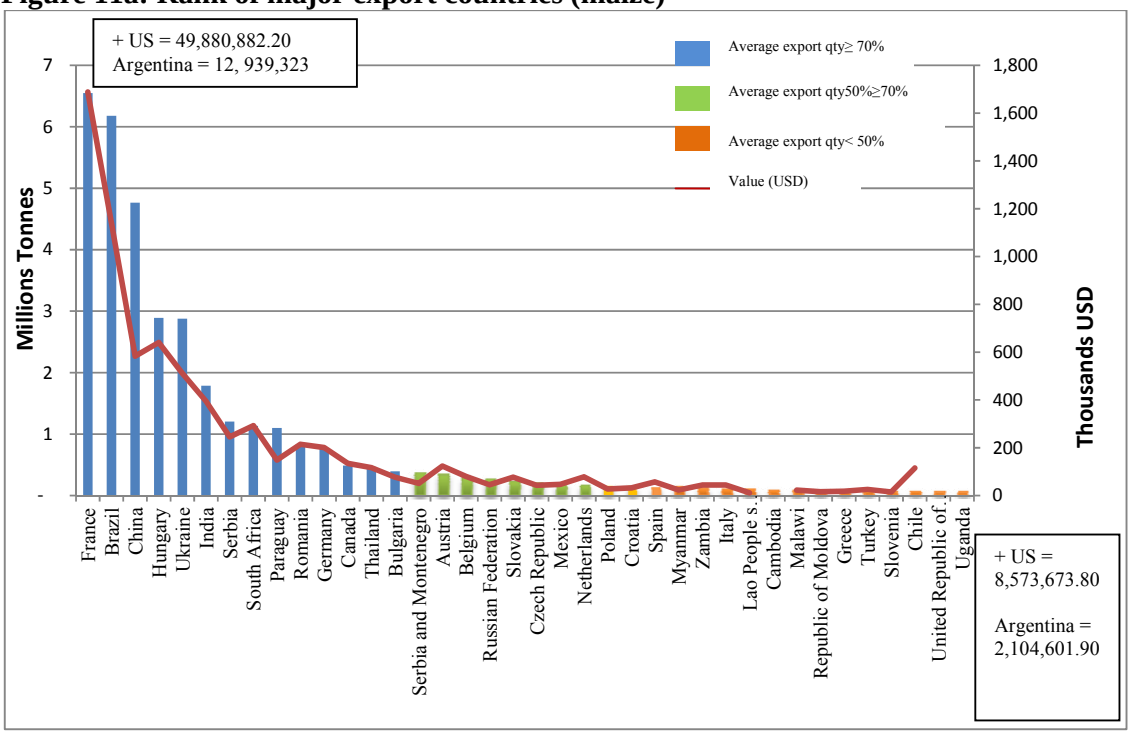
4.1.2 Which countries are the major importers and exporters in maize rice and wheat over time?

4.1.2.1 Rank of maize exporters, importer and producers

United States and Argentina emerged as the highest maize exporters, out of the selected 40 major exporters represented in figure 11a. The selected 40 major countries have over the 10 year period (2002-2011), exported more than 70% of the aggregate export of the 170 countries recorded by FAO dataset for maize export.

The average export for the major export countries revealed that, in addition to US and Argentina; countries such as France, Brazil, China, Hungary and Ukraine, including India and South Africa, remain the major command centres within the global network of maize export. These countries export on the average, over 70% of aggregate export of the major export countries.

Figure 11a: Rank of major export countries (maize)



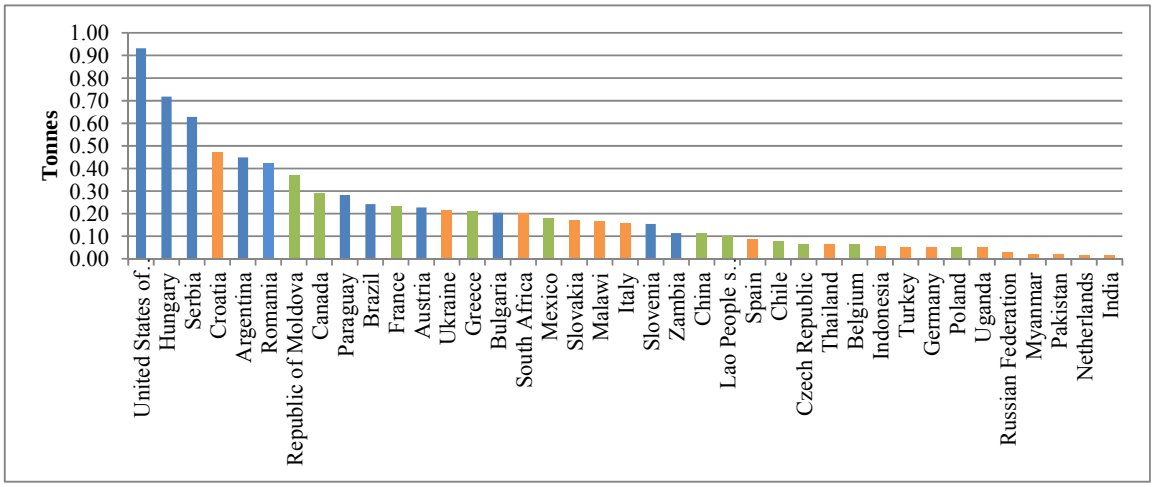
Source: author (2014) calculated based on the Faostat (2013)

Spain and Italy, despite their position for export quantity have a higher share in export value than Bulgaria. This implies that, the USD value of maize per tonne from these countries commanded high value than the maize from Bulgaria.

Comparing export countries and their production per capita (figure 11b), Croatia, emerged as one of the highest per capita producers with its per person average production at 0.47 tonnes, higher than that of Argentina, despite its position as a major producer and the 2nd global exporter.

The production capacities of these countries suggest that

Figure 11b: Average production per capita for major export countries

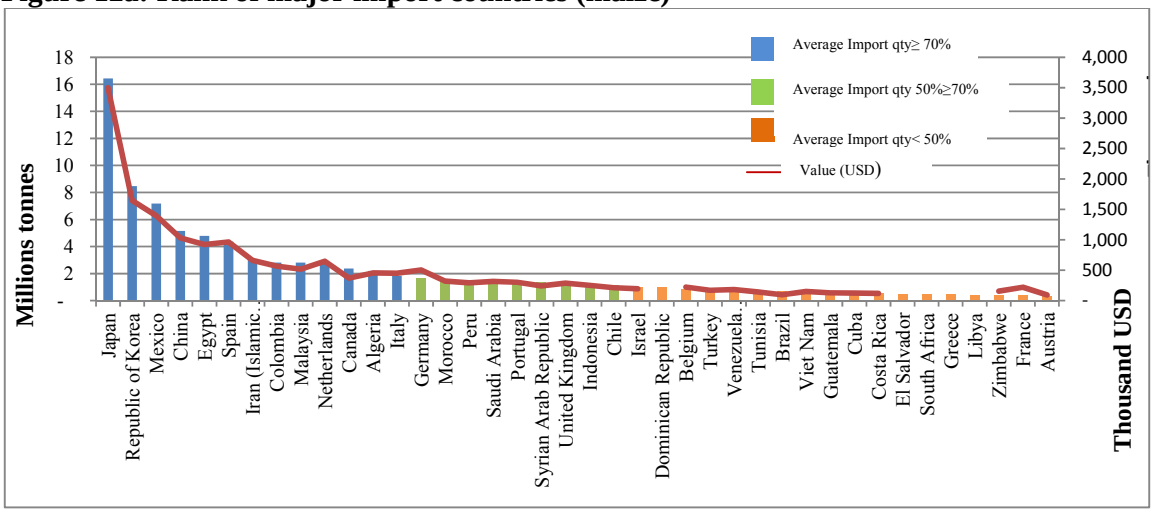


Source: author (2014) calculated based on the Faostat (2013)

Other major producer countries such as China, Brazil, Mexico, India, and France have also been overtaken by Croatia in terms of per capita production. It therefore implies that higher production is expected in countries with higher populations and comparative advantages.

Major import countries such as Japan, Republic of Korea, Malaysia and Algeria shown in figure 12a are deficient in maize production as a result of unfavourable geographic location and conditions, hence the result of their high average imports. China and Mexico's average imports can be attributed to the high population, which support maize consumption, and their trade positions as major exporters. The Netherland's position as an exporter also accounts for its average import value above, considering its low production per capita.

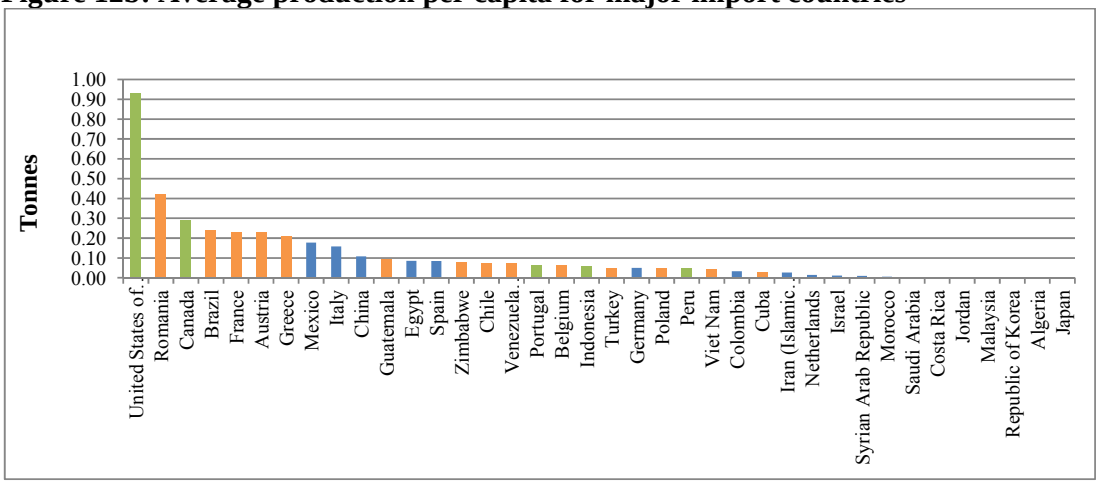
Figure 12a: Rank of major import countries (maize)



Source: author (2014) calculated based on the Faostat (2013)

Furthermore the import value analysis shows that Jordan, Poland and Romania, have replaced Dominican Republic, El Salvador and South Africa among the 40 major importers. This implies that the import value of these new countries outweighs that of these replaced countries. Other reasons accounting for the change and import value difference can be explained by the quality or type of maize imported and domestic import taxes and charges.

Figure 12b: Average production per capita for major import countries

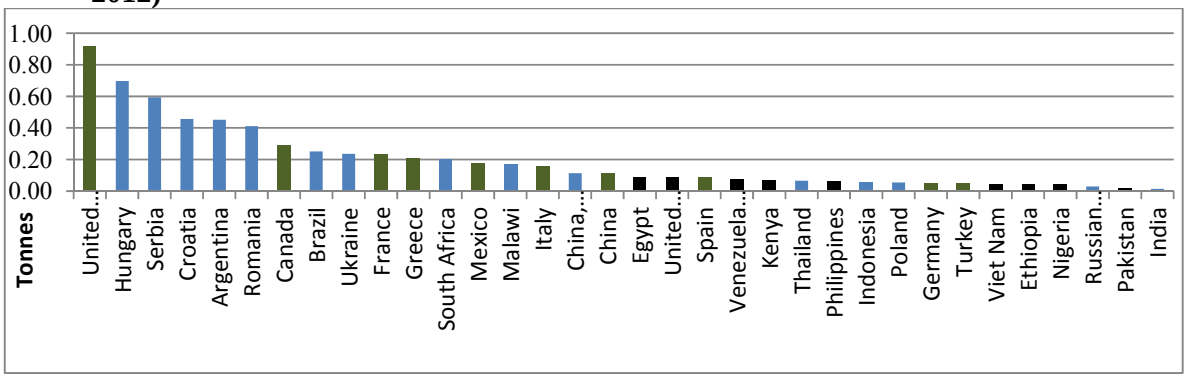


Source: author (2014) calculated based on the Faostat (2013)

Average production per capita is lower than 0.20 tonnes for all importing countries, excluding US, Canada, France, Austria and Greece. However the import position of Japan, Algeria, Republic of Korea, Malaysia and Jordan, including Costa Rica and Saudi Arabia is explained by their per capita production of 0.00 tonnes.

It can be inferred that, these countries will continue to depend heavily on maize import for their domestic food and feed and as such may be vulnerable in case of shocks. However their comparative advantage in other cereal production could trade off to some extent their vulnerability in maize.

Figure 13: Average production per capita for major maize producer countries (2002-2012)



Source: author (2014) calculated based on the Faostat (2013)

Major Producers missing in the 40 major Exporter (value) category

Countries in 40 major world Exporter and Importer (value) category

40 Major exporter (value) category only

Major producers such as Egypt, United Republic of Tanzania, Venezuela, Vietnam, Nigeria and Ethiopia are major producers but not exporters. Their average export value falls within the range below $43,803.8 per annum. Meanwhile Egypt, Indonesia, Venezuela, and Vietnam are major producers and importers.

This implies that there is the need for further improvement in yield per hectare in order to increase production volume to meet domestic demand for feed and food in these countries. On the other hand, the countries may require financial resources to increase import, as their population continue to increase; the demand for maize as feed and food also increases.

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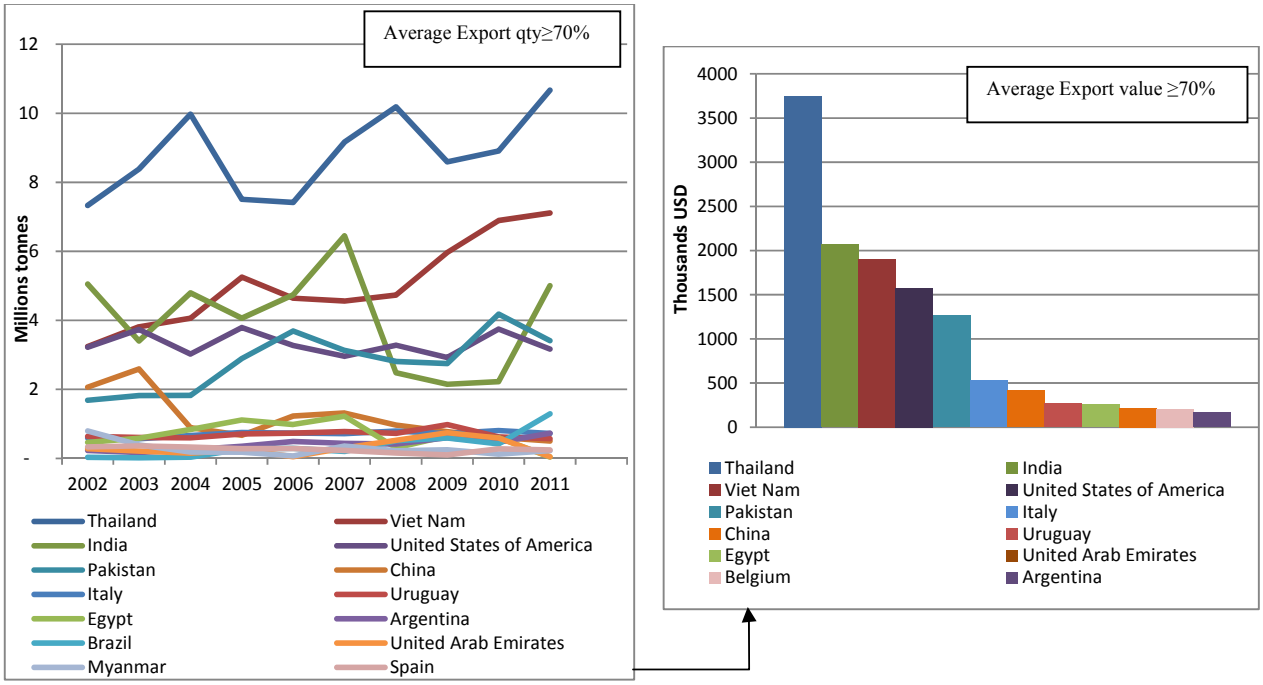
4.1.2.2 Rank of rice exporters, importers and producers

Thailand, Vietnam, India, United States and Pakistan have emerged as the five major exporters that have shown significant resilience to maintain leading positions amidst unfavourable wheather conditions of El Niño (warm) and La Niña (cold) associated with series of floods and droughts, price variability and changing consumer preferences, out of the 14 countries shown in figure 14a and b.

Figure 14a: Trend of major rice exporters **Figure 14b: Average export value**



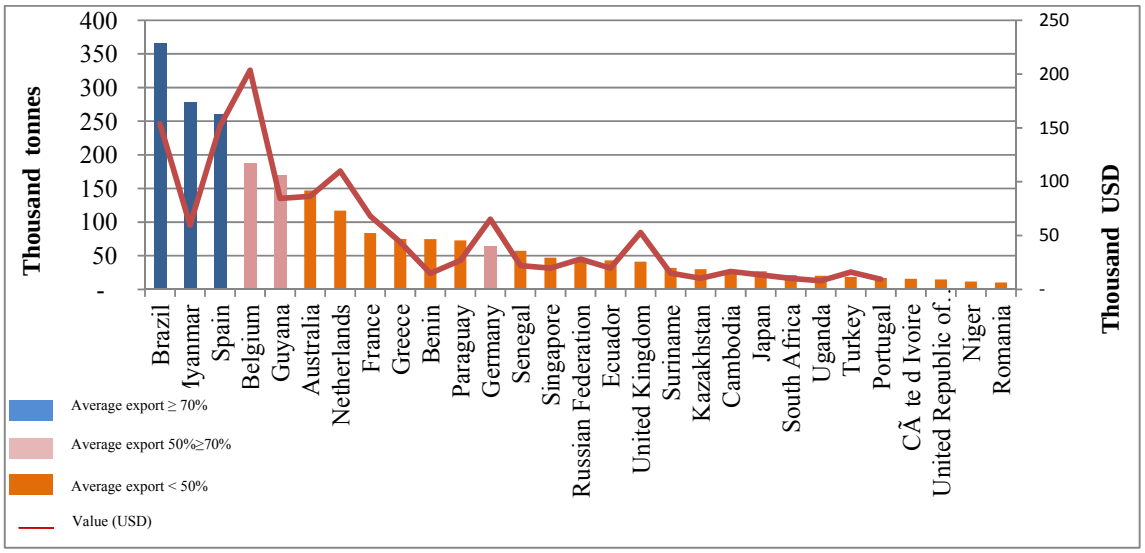
Source: author (2014) calculated based on the Faostat (2013)

Consequently export values have shown 50% value difference between the five major export countries against the aggregate value of the other 35 countries in the 40 major export category.

This shows that the five countries over the review period are command centres for global rice export. A significant shock in quality and quantity among the five main exporters will influence global rice trade.

United Arab Emirates and Belguim have higer export value (USD), but are not recorded as rice producers in the FAO dataset. Per the FAO data set, other non rice producer countries within the 40 major export category include Netherland, Germany, Oman, Singapore, and the United Kingdom.

Figure 15a: Major rice export countries (2002-2011)

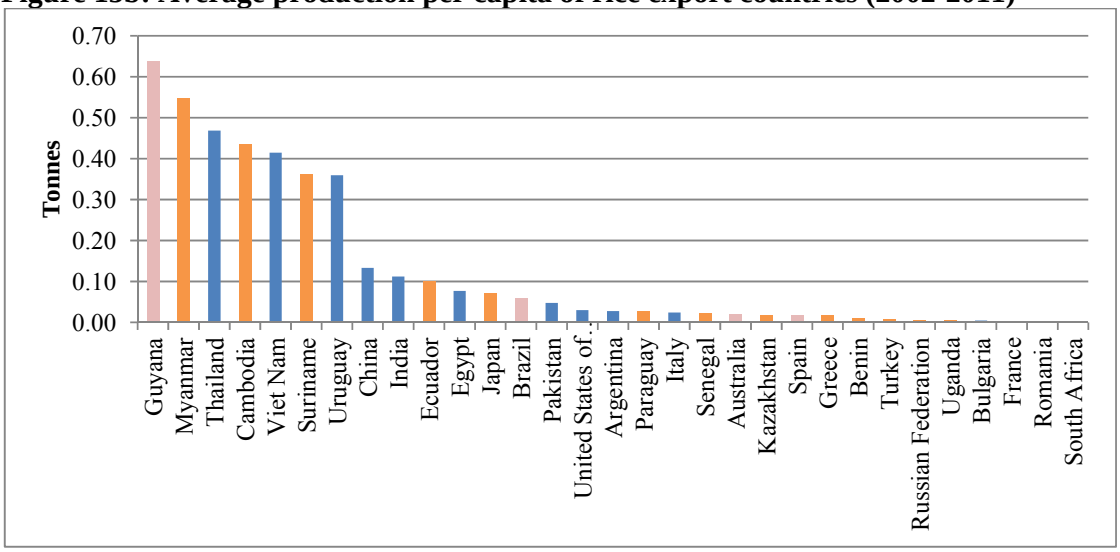


Source: author (2014) calculated based on the Faostat (2013)

Brazil, Myanmar and Spain have their export value lower than Belgium and less than the 70% category, despite their position in export quantity. This can be explained by factors such as dollar value and quality attached to rice from Belguim.

figure 15b indicates that per capita production for major exporting countries such as United states, Pakistan, Brazil, Italy and France is below 0.01 tonnes. However, Guyana and Myammar have the highest per capita production displacing Thailand, the major exporter in the wolrd. It is expected that countries with increased population should have more labour force agriculture cultivation.

Figure 15b: Average production per capita of rice export countries (2002-2011)

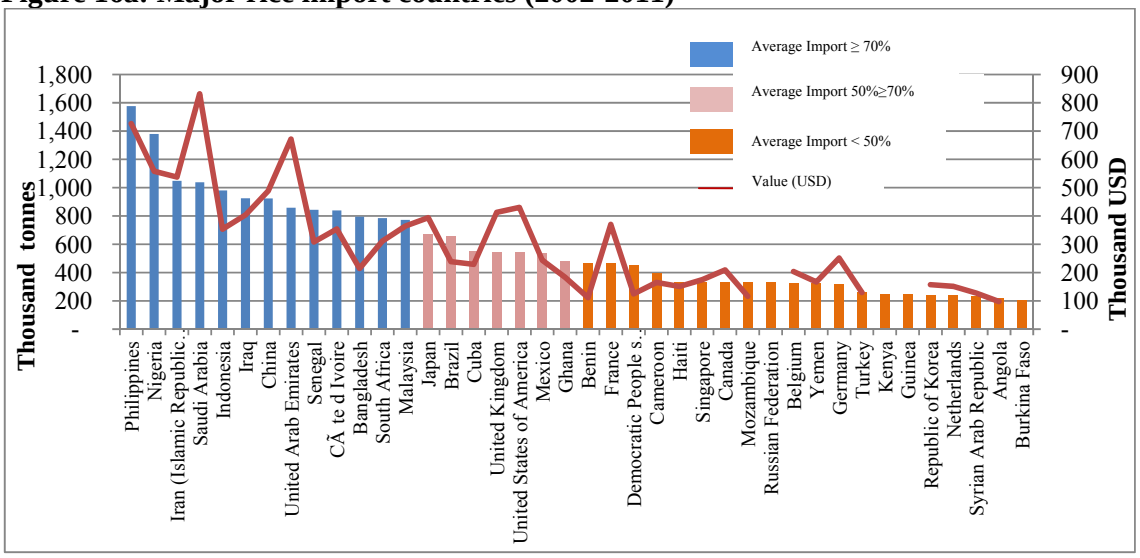


Source: author (2014) calculated based on the Faostat (2013)

Fifty one percent 51% of the 40 major import countries are from Asia whilst Africa makes up twenty nine (29%) with the rest of Europe and Latin America making up twenty percent (20%).

The import quantities of Brazil, United Kingdom, France, and Germany including Belgium as shown by figure 16a can be explained by their export quantities; however it should be noted that these countries are likewise non rice producing countries and are consequently not heavy consumers of rice. Hence import and export (trade) in rice is one of the significant components of their national economic sector. The results confirm the argument by Storper that a country is successfully specialised in today's world economy when its share of exports of a specific product is higher than its share of world trade (Storper, 1992). Brazil, United Kingdom, France Germany and Belgium provide evidence of this claim.

Figure 16a: Major rice import countries (2002-2011)

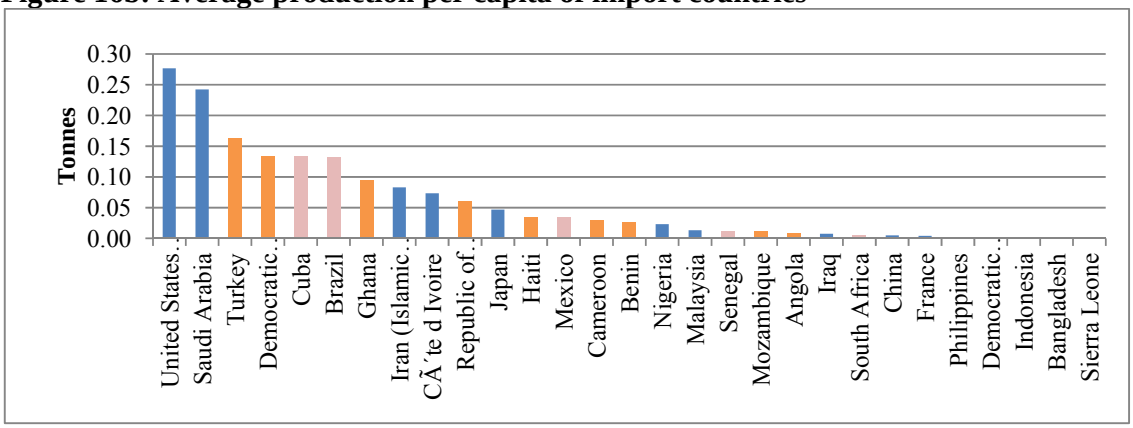


Source: author (2014) calculated based on the Faostat (2013)

Import values of African countries within the major import category reveals that rice consumption in Africa has increased over the review period as compared to the rest of the world, excluding Asia. Furthermore Kuwait, Oman, Sierra Leone and Democratic Republic of Congo replaced Russia Federation, Kenya, Guinea and Burkina Faso in import value

Results of figure 16a reveals that import values of Nigeria, CÃ´te d Ivoire, South Africa and Senegal are higher than Belgium, a major exporter; whilst Ghana and Cameroon in addition to the already mentioned African countries have their import values higher than that of other major exporters namely Singapore, the Netherland and Oman. This phenomenon explains the effect of global rice value on the economies of these African countries. Since the import quantities are major supplement to Africa's domestic rice consumption, the preference for the imported rice implies that the middle and low urban population will be at risk to food insecurity as a result of the high value and their ability to afford (Demont, 2013).

Figure 16b: Average production per capita of import countries



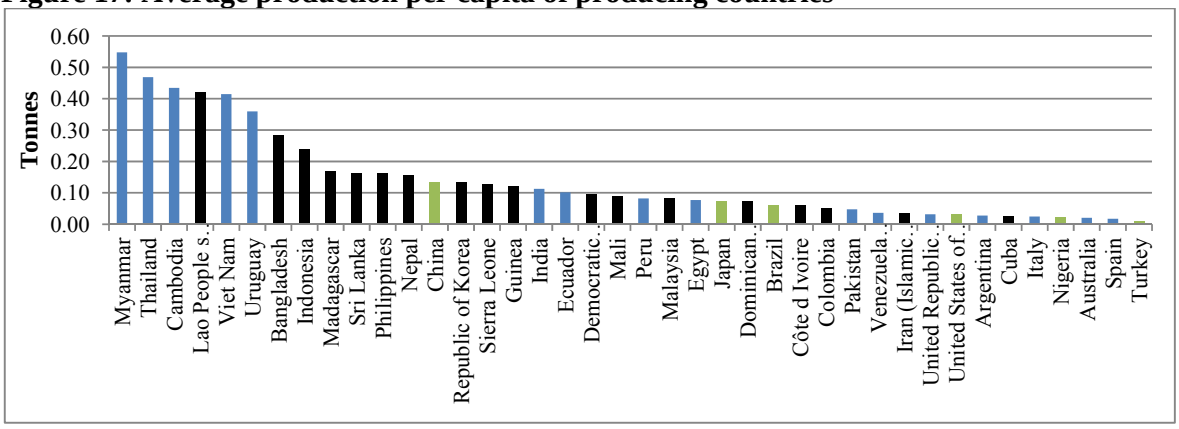
Source: author (2014) calculated based on the Faostat (2013)

Production per capita of import countries (figure 16b) reveals that rice cultivation is concentrated in very, special conditions with a hand full of Asia and Africa countries engaged in it. Production per capita is generally very low for the import countries. Sixty five (65%) of major importers have production per capita below 0.05 tonnes leaving Bangladesh and Indonesia as the highest rice producers per capita with values between 0.20 and 0.30 tonnes.

The analysis of average production per capita (figure 17) reveals that Canada, Kuwait, Yemen, Syrian Arab Republic and Oman have not been recorded as producers in the FAO dataset within the years under review. This implies that these countries are non rice producers, though they are major consumers of rice. Additionally, with an average export value in the range of $6,800 and less, rice remains a major component of their domestic food consumption.

China, Indonesia, Bangladesh and the Philippines including 6 others are both major rice producers and importers. The statistics reveals that large production volumes are in the hands of a few countries. Hence any reduction in production volumes of these countries will adversely impact food security of dependent nations. The results of the major rice dependent countries confirm the argument that the achievement of long term food security would not be guaranteed when countries are dependent on imports to supplement its consumption (Demont, 2013).

Figure 17: Average production per capita of producing countries



Source: author (2014) calculated based on the Faostat (2013)

Major Producers missing in the 40 major Exporter (value) category

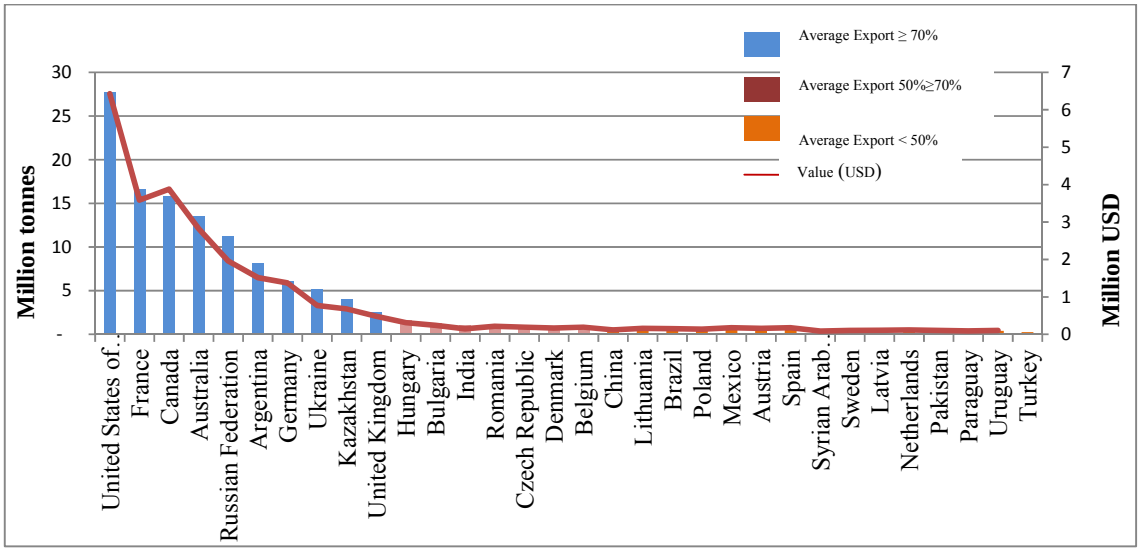
Countries in 40 major world Exporter and Importer (value) category

40 Major exporter (value) category only

4.1.2.3 Rank of wheat exporters, importers and producers

United States is the highest wheat exporter, with other major exporters concentrated in the European region and a selected few Latin America and Asia countries.

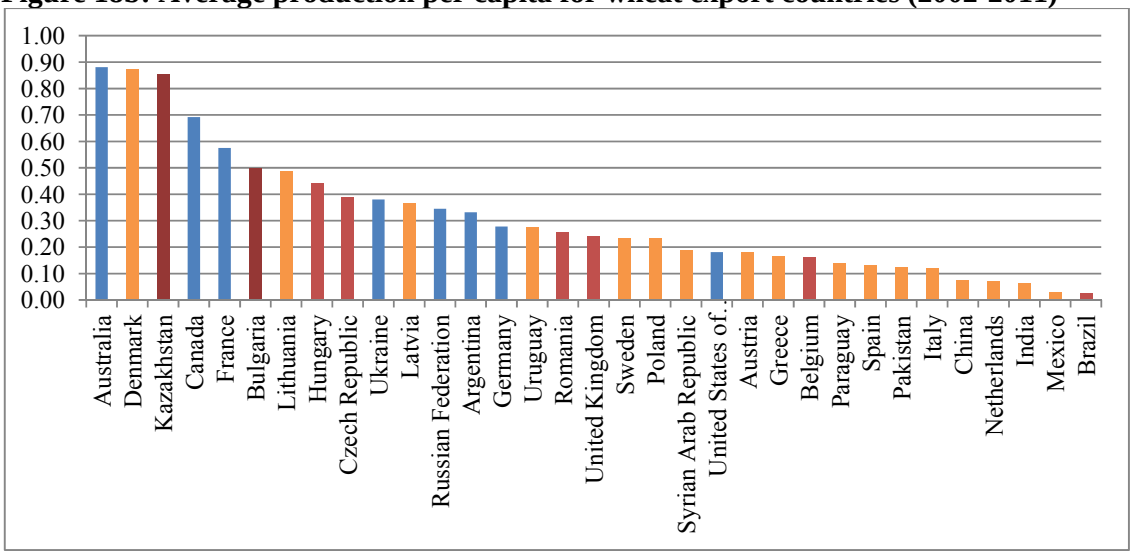
Figure 18a: Major wheat export countries (2002-2011)



Source: author (2014) calculated based on the Faostat (2013)

India has a lower ranking in value compared to Belgium and Mexico despite its higher position in export quantity. This implies that the value per tonne for wheat in Belgium and Mexico are higher than in India. It could be inferred that value per tonne of wheat is dependent on the origin and invariably the quality. Greece and Italy replaced Turkey in the value category of major export countries.

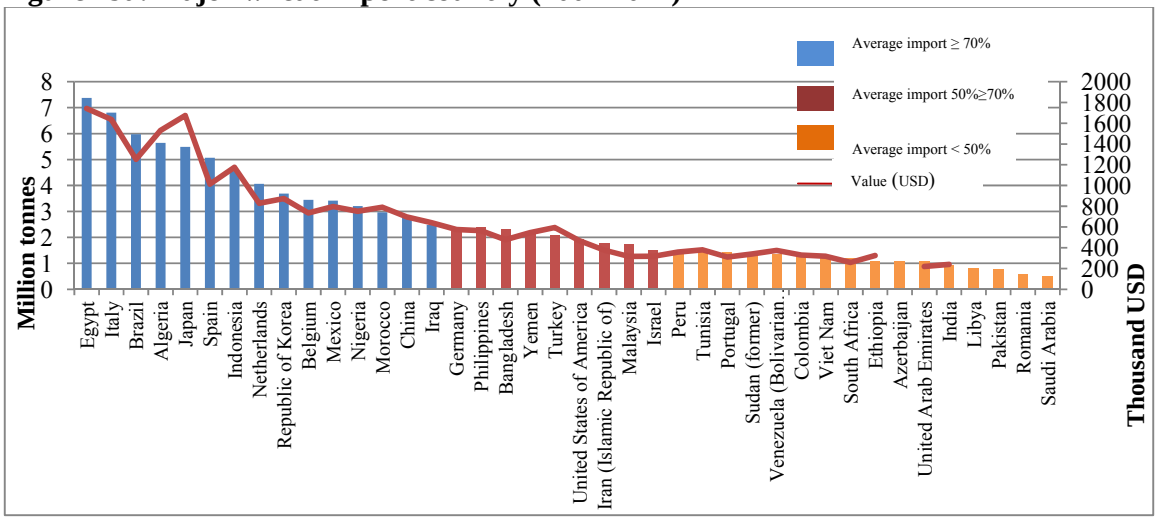
Figure 18b: Average production per capita for wheat export countries (2002-2011)



Source: author (2014) calculated based on the Faostat (2013)

Production per capita for wheat (figure18b) is generally high, with little variations between countries. This implies that most of the wheat export countries are wheat producers with high yield per hectare.

Figure 19a: major wheat import country (2002-2011)



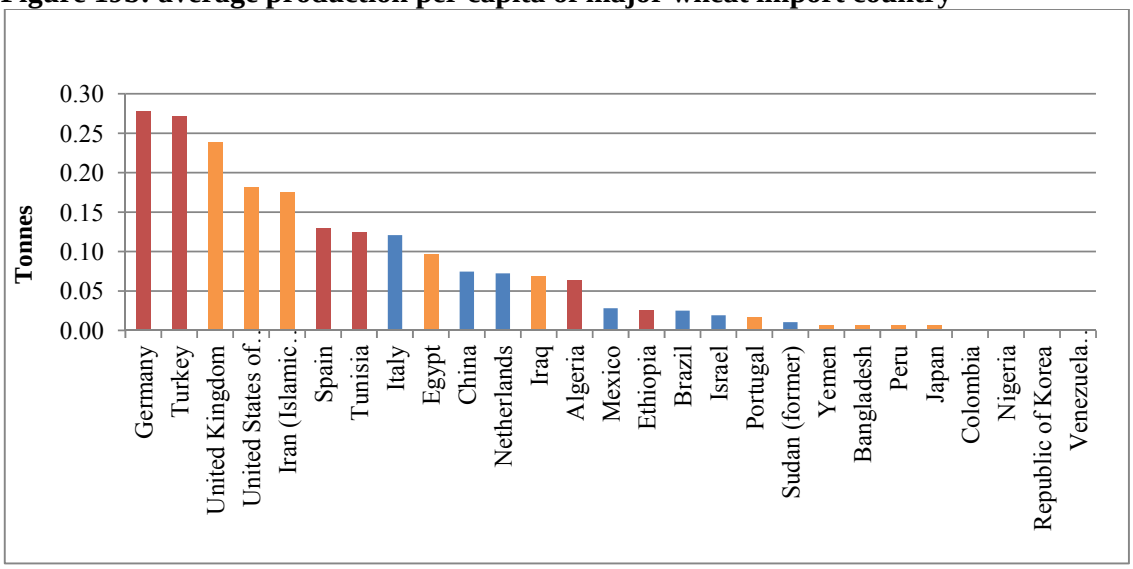
Source: author (2014) calculated based on the Faostat (2013)

Figure 19a reveals that 50% of the major exporters are also major importers. United States, Germany, and Ukraine with key positions in wheat exporting are represented as major importers. Their imports are for purposes of supplementing export trade and domestic stock.

Egypt, Morocco, Nigeria, Tunisia and Ethiopia are major wheat importers in Africa, with Egypt recorded as the world largest importer. Average production per capita for Africa is almost zero.

This further reveals the dependence of Africa on wheat import for domestic consumption. Moreover consumption preference for wheat and its related products are on the increase.

Figure 19b: average production per capita of major wheat import country



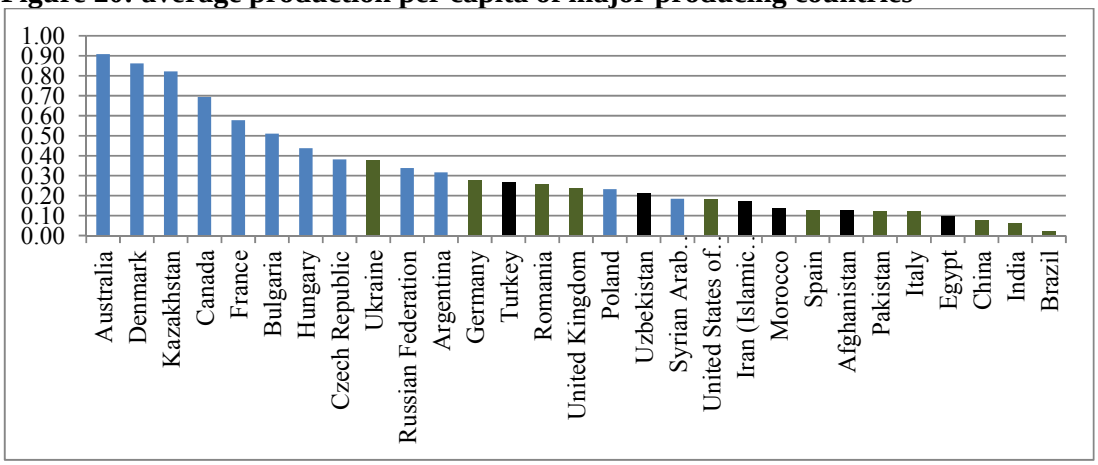
Source: author (2014) calculated based on the Faostat (2013)

Figure 19b revealed that Egypt has the potential to increase its per capita production and improve domestic production whilst Japan, Colombia and Nigeria, including Republic of Korea, China and Venezuela has 0.00 tonne as production per capita; this reveals almost a production ratio of 0% and a complete dependence for these countries on wheat.

However, the ability of these countries to pay for import values determines their vulnerability. Consequently, the differences in vulnerability impact.

Average production per capita of major producing countries (figure 20) revealed that Egypt, Iran, Morocco and Turkey are major Producers. However they are also major importers, but are not within the major export category. The implication is that, there is a mismatch in the demand and supply of wheat for these countries. They also have the potential to increase production, than they are currently producing. The current position of their supply chain implies that these countries require financial resources to continue importing wheat.

Figure 20: average production per capita of major producing countries



Source: author (2014) calculated based on the Faostat (2013)

Major Producers missing in the 40 major Exporter (value) category

Countries in 40 major world Exporter and Importer (value) category

40 Major exporter (value) category only

In general, countries recorded as major producers and importers, but are not represented as major exporters require further improvement in their productivity. On the other hand, countries recorded as major importers, but are not producers or major exporters will also need to improve productivity in other comparative or competitive advantaged sectors to facilitate trade off. With the current instability in international price for grains, more government and institutional structural interventions are required to improve future grain security (Demont, 2013).

In summary, the countries in the table below are global supply centres in Maize, Rice and Wheat. They hold the pillars of food security for the rest of the world with their production volumes, export quantities and the trade networks (import and export relations).

Table 8: Global grain suppliers (2002-2011)

North America	Europe	CIS	Asia	Latin America and Caribbean	Africa
United state	France	Ukraine	Thailand	Argentina	South Africa
Canada	Germany	Hungary	Vietnam	Australia	Egypt
	Belgium	Uruguay	Myanmar	Mexico	Zambia
	Netherlands	Romania	India	Brazil	Malawi
	Austria	Russia	China	Chile	Benin
	Denmark	Croatia	Malaysia		CÃ’te d Ivoire
	Italy	Greece	Pakistan		Niger

Source: author (2014) calculated based on the Faostat (2013)

This implies that majority of grain exports to importing countries, in relation to food and feed are supplied from these countries, hence trade policies, climate conditions, technology and research available from these centres will influence global grain security in the rest of the world.

Summary on the ranks of major import and export countries

The statistics reveals that large production volumes are in the hands of a few countries. Hence any reduction in production volumes of these countries will adversely impact food security of dependent nations.

Africa and especially West African countries are major importers of wheat and rice resulting from their presence in the major category of import. This indicates that food production especially for rice and maize need to improve to ensure food security.

Major exporters are also major importers. This they do, for the improvement of their export share in the world economy of grain trade.

Fifty percent (50%) of the major exporters are also major importers. United States, Germany, and Ukraine with key positions in wheat exporting are represented as major importers. Their imports are for purposes of supplementing export trade and domestic stock

Five major rice countries from Asia and North America accounts for 50% of world export

The results of the major rice dependent countries confirm the argument that the achievement of long term food security would not be guaranteed when countries are dependent on imports to supplement its consumption (Demont, 2013).

With the recent instability in international price for grains, more government and institutional structural interventions are required to improve future grain security, especially for the African region.

4.1.3 Import growth of regions in maize, rice and wheat

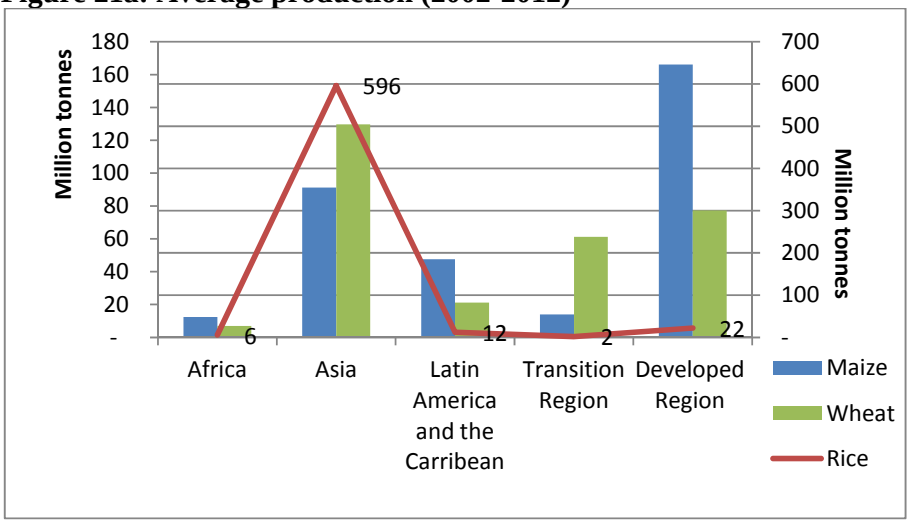
Comparing developed and developing regions

The analysis of average production, of developed and developing economies[2] as shown by figure 21a revealed that Asia is the world leading producing region for rice and wheat from 2002 -2012. Its production for wheat is led by China, India, Pakistan, Turkey and Iran and that of rice is also led by the producing countries, China, India, Indonesia, Vietnam, Thailand and the Philippines.

The world's leading region for Maize production is the developed region led by producing countries; United States, France, Canada, Italy, Romania and Hungary.

[2] Developed and developing economies: classified based on region, see further explanation in annex 1

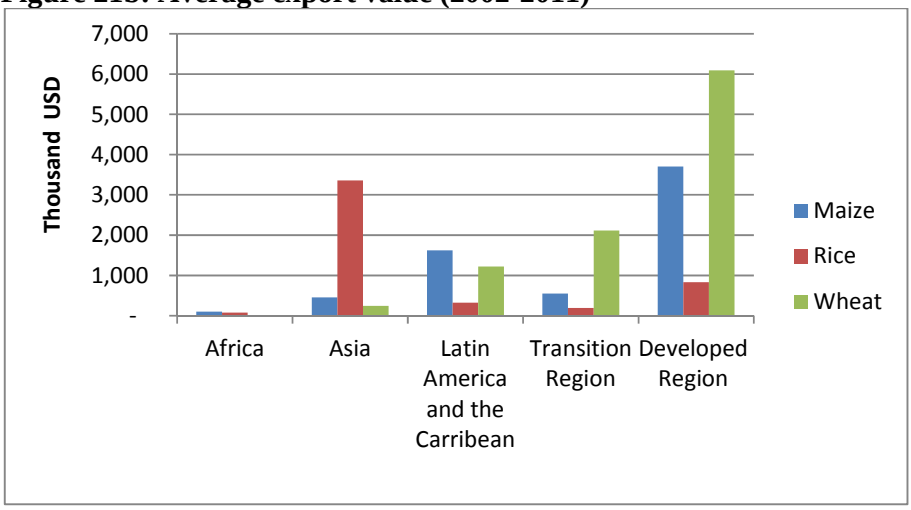
Figure 21a: Average production (2002-2012)



Source: author (2014) calculated based on the Faostat (2013)

Figure 21b showed that; the major exporters of wheat and maize are from the developed region, whilst major rice exporters are from developing economies in the Asia region. The African region exports for all three grains.

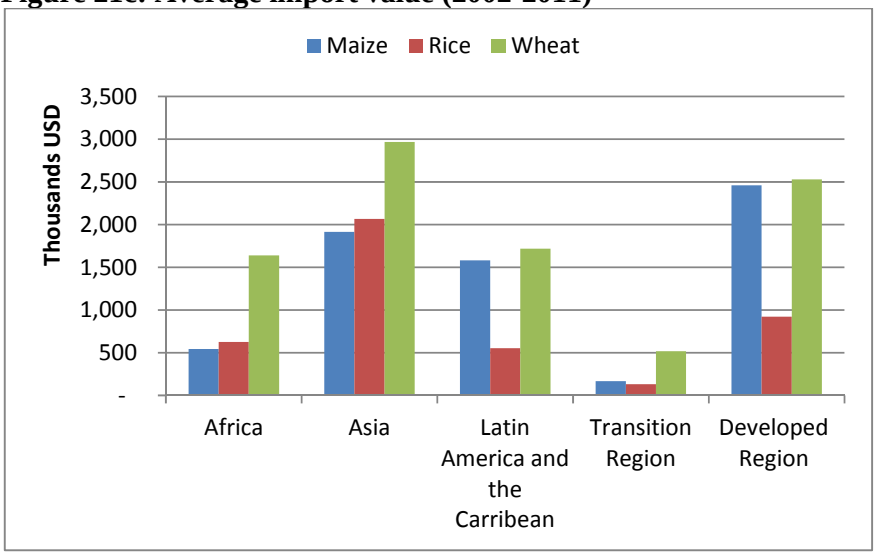
Figure 21b: Average export value (2002-2011)



Source: author (2014) calculated based on the Faostat (2013)

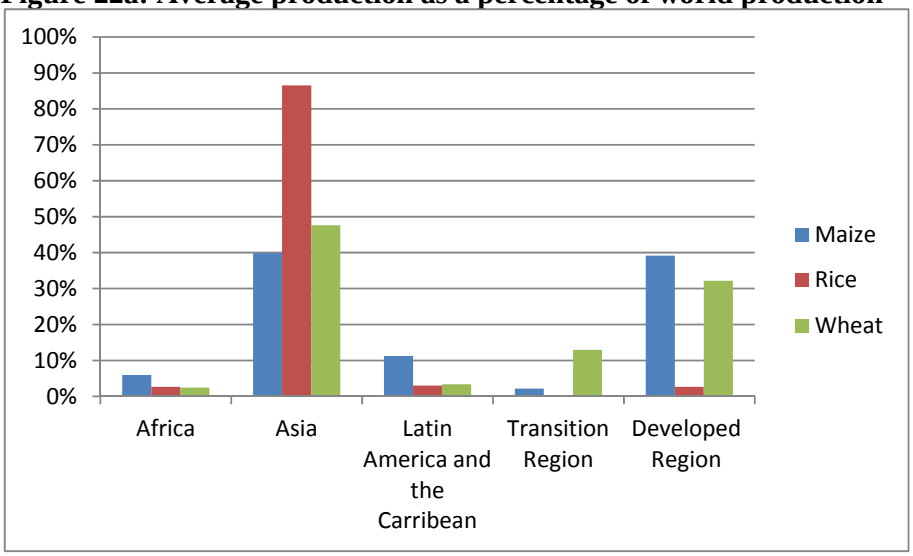
In figure 21c, Asia has the highest aggregate import value. This is followed by the developed region, Latin America and the Caribbean, Africa and lastly transition economies. Imports by developed and transition regions have more than 50% share export component, whilst imports by Asia has 55% and that of Africa, has more than 90% component as supplement to domestic food consumption and feed. Latin America and the Caribbean has 40% component of its import as export (trade).

Figure 21c: Average import value (2002-2011)



Source: author (2014) calculated based on the Faostat (2013)

Figure 22a: Average production as a percentage of world production

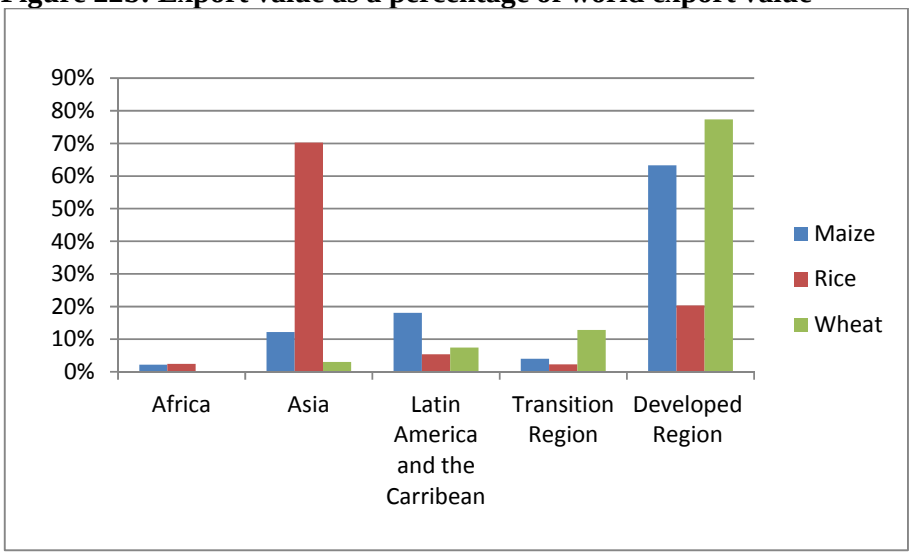


Source: author (2014) calculated based on the Faostat (2013)

Asia is the leading region in the developing economies with production ratio of 39.88% and 47.65% for maize and wheat as contribution to global production followed closely by 39.18% and 32.18% for maize and wheat as contribution from, developed region. The aggregate percentage volume from Africa, Latin America and the Caribbean, and also the Transition region has less than 1/4th contribution to global production.

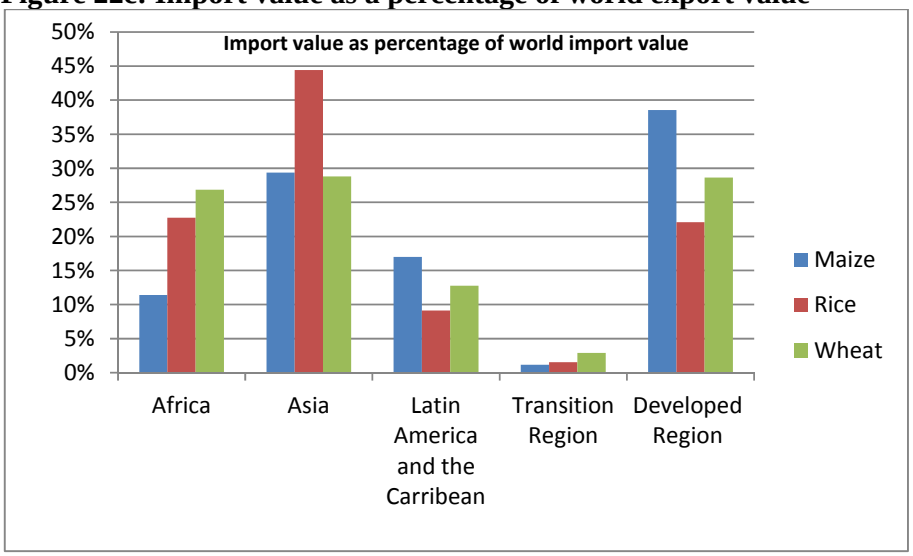
Comparing export and import percentages shown in figure 22b and 22c, the highest export contributors to global food consumption are from the developed region, followed by Asia from the developing region.

Figure 22b: Export value as a percentage of world export value



Source: author (2014) calculated based on the Faostat (2013)

Figure 22c: Import value as a percentage of world export value



Source: author (2014) calculated based on the Faostat (2013)

The African region occupies the 3rd position for world imports, and their imports are essentially a supplement to domestic food consumption whilst the region contributes the least to global export and production. Hence the huge import dependence for these grains.

Out of the percentage contributions presented in the figure above, the percentage import rate of maize, rice and wheat, from Asia, has its 75% ration, constituting a supplement to their domestic food consumption. Furthermore, the transition region and Latin America and the Caribbean have less than 40% of their import proportion constituting a supplement to domestic food supplement, whilst the other 60% proportion is for industrial use (ethanol and starch).

The comparison of figure 22b and 22c revealed that, the regions of Asia and the Latin America and the Caribbean are major exporters to the rest of the world from the developing region whilst the Transition and developed regions are the major contributors to world trade (export and import). This is because most of their import is further exported as food, ethanol or starch.

In summary, the phenomenon presented by the figures revealed that Africa is the most disadvantaged in food security from the developing region, this is because, it is the least contributor to global production and export, but with relative high contribution to import with 26.86% for wheat, 22.76% for rice and 11.40% for maize. This shows huge consumption supplement by imports and the subsequent effects that may result from variability in weather, price, trade policy and self-sufficiency from exporting regions.

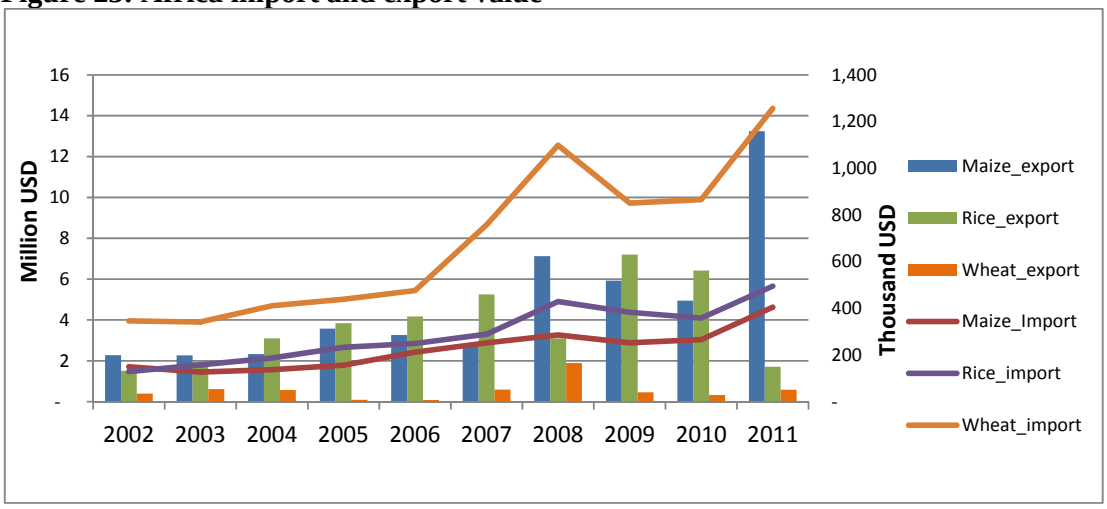
Which countries have higher import dependency in West Africa and which countries supply the West African region?

4.1.4 Growth of Africa and West African import activities in maize rice and wheat

Growth of Africa Region

The import value for the grains, have been rising over the period, marginal increases were experienced from 2006 through 2007, and this picked up sharply in 2008 as a result of huge price increase as articulated in the literature from Sonnino (2009), Brooks et al (2013) and Tadesse et al., (2013). Value reduction from 2008 to 2009 can also be attributed to the reduction in quantities purchased on the world market as a result of the price increase which reduced purchasing power.

Figure 23: Africa import and export value



[3]

Source: author (2014) calculated based on the Faostat (2013)

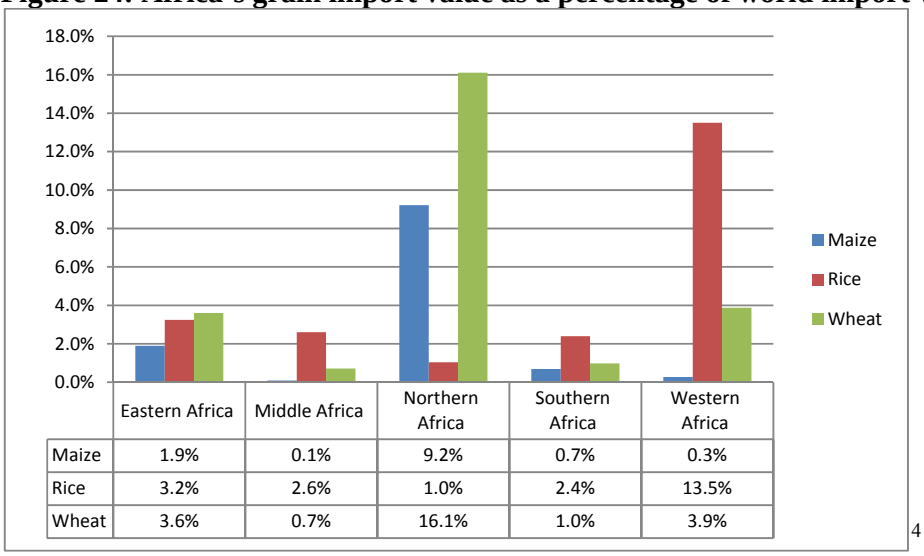
[3]All Import and Export Values are 1000 USD

Exports of African Countries have not shown significant changes as is the case of imports. Record high export values experienced in 2011 and 2008 for maize, are due to the events of fuel price increase and demand for maize for fuel as discussed in previous sections. The 2009 and 2010 export value for rice can be attributed to governments' initiatives to improve rice production after the 2008 phenomenon, when import values widened the trade deficits of countries.

The initiatives especially in West African countries pushed up production and export quantities by 2%, thereby improving export quantity, hence a rise in export value. However 2011 export quantities reduced significantly due to the climatic conditions experienced in that period.

Generally, it can be inferred that, the suitable geographical condition for rice in addition to government and institutional ability to improve production to safeguard rice security, resulted in the improved exports in 2009 and 2010. Furthermore improves regional grain security can be achieved if the hysteresis and path dependence of reactive short-term measures are improved to include long term measures and adaptability.

Figure 24: Africa's grain import value as a percentage of world import value



	Eastern Africa	Middle Africa	Northern Africa	Southern Africa	Western Africa
Maize	1.9%	0.1%	9.2%	0.7%	0.3%
Rice	3.2%	2.6%	1.0%	2.4%	13.5%
Wheat	3.6%	0.7%	16.1%	1.0%	3.9%

[4]

Source: author (2014) calculated based on the Faostat (2013)

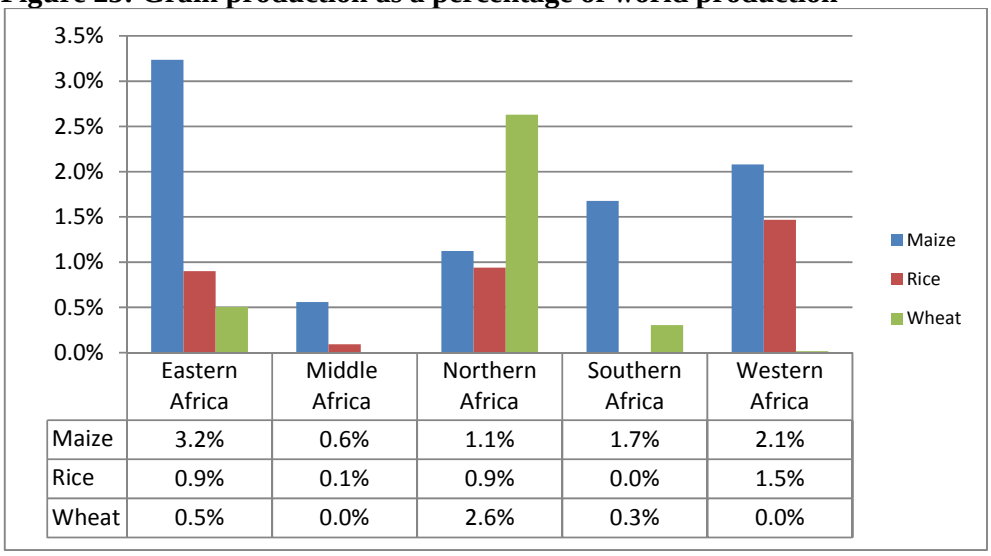
Figure 24, show that the North African region is the leading region in wheat and Maize imports, whilst the West Africa region leads in rice imports. East Africa grows and consumes more of its domestic rice, thereby importing less, whilst in the West African region, rice imports constitute domestic consumption. West Africa percentage rice import is a result of its taste preference for imported rice to the detriment of its domestically cultivated rice, this results confirms the argument by Demont, (2013).

The author stated that the quality and image improvement in rice is necessary to compete with the imported rice in the domestic market. She argued that the demand for imported rice is not patronised because of its foreignness but due to it quality and taste.

[4] Refer to annex for the description of Africa country classification according to regions

The East African region is the leading producer of maize in Africa as presented by figure 25. This is followed by the West African region, before Southern African region. Meanwhile South Africa is one of the major producer's of maize in the world. On the other hand, East Africa is the 2nd highest maize importer, despite having the highest maize production in Africa. This implies that the regions maize consumption is higher than its production.

Figure 25: Grain production as a percentage of world production



	Eastern Africa	Middle Africa	Northern Africa	Southern Africa	Western Africa
Maize	3.2%	0.6%	1.1%	1.7%	2.1%
Rice	0.9%	0.1%	0.9%	0.0%	1.5%
Wheat	0.5%	0.0%	2.6%	0.3%	0.0%

Source: author (2014) calculated based on the Faostat (2013)

In terms of global wheat production, North Africa produces the highest quantity of 2.6% compared to its import of 16.1%. The West African region is the 2nd least producer after Middle Africa, however it is the 2nd highest importer. East Africa's production of 0.5% is the 2nd highest, with leading production from Ethiopia, Kenya, Zambia, Zimbabwe and Tanzania.

The growing demand evident from the data analysed, shows that wheat imports will continue to be a major contributor of Africa's grain dependency. The region has no known tradition in wheat cultivation, but the recent preference for wheat consumption and the forecast increase demand will continue to widen its trade deficit, as production does not improve. The leading producers of wheat in Africa are led by Egypt, Morocco, Algeria, Ethiopia, South Africa and Tunisia. This shows that North and East Africa has the potential to improve production for Africa.

In the next session the study will focus on the West African region[5]. This is done to analyse, the countries with high imports and which countries have higher dependency.

4.1.5 Countries with High import dependency in West Africa

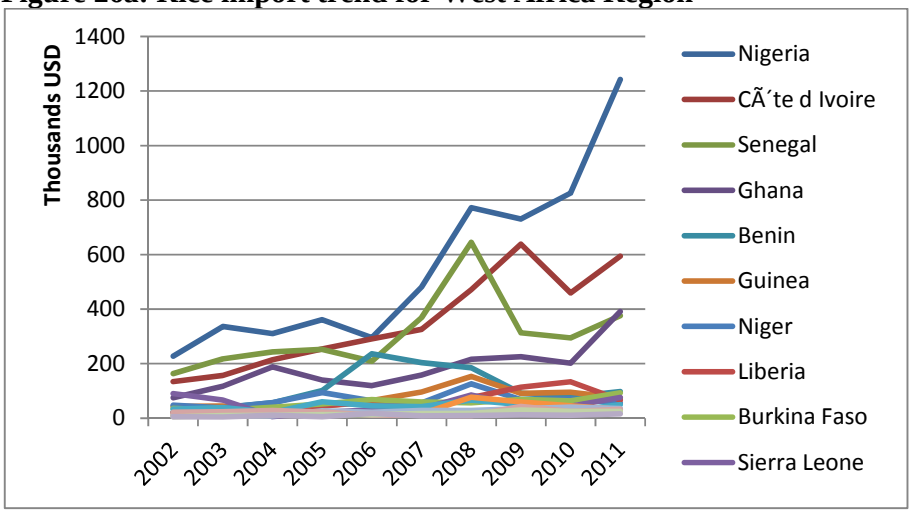
Nigeria has the highest rice import in West Africa region. It also appears in the world's 40 major importers, in addition to Senegal, CÃ'te d Ivoire, Ghana and Benin. The trend shows a sustained increase from 2006 to 2011, with slight reductions in 2009 and 2010 for most

[5] West Africa Region: refer to annex for country classification

countries as shown in figure 26a. However, rice imports picked up slowly for most countries from 2010 upwards.

It could be implied that import quantities may have been reduced to accommodate changes in value. During the 2010 fiscal year, most West African countries recovered their import quantities after the 2008 and 2009 price surge. This resulted in sustained increase in import values from this period on.

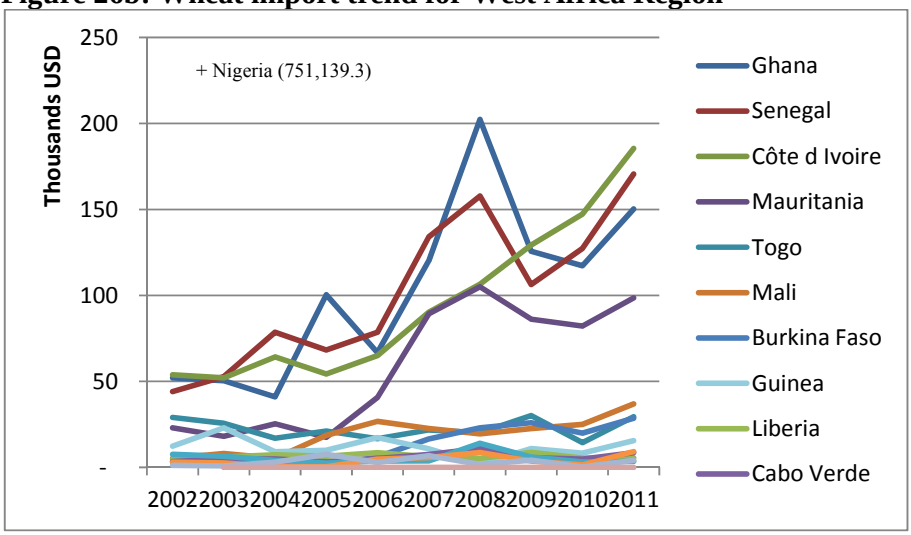
Figure 26a: Rice import trend for West Africa Region



[6]

Source: author (2014) calculated based on the Faostat (2013)

Figure 26b: Wheat import trend for West Africa Region



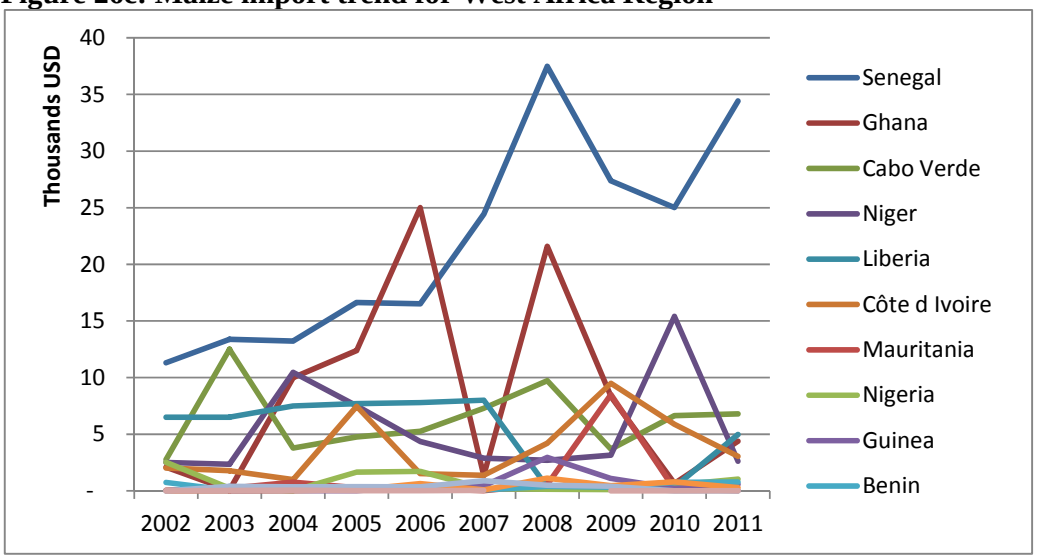
Source: author (2014) calculated based on the Faostat (2013)

[6] All Import and Export Values are in 1000 US$

The average import range of Wheat for Nigeria (figure 26b); outweighs the average range of other countries in the region. Its position in the world major wheat importers shows the extent of consumption, which is driven by its large population size.

Furthermore, Ghana's average range, which reached its peak records in 2008, shows the trend of sustained increase in wheat consumption over the period. CÃ´te d Ivoire and Mauritania's consumption pattern also showed sustained increase from 2005 to 2010, despite a marginal reduction experienced in 2010, which may have resulted from the after math effect of the 2008-2010 economic down turn, however, it immediately recovered its import value within the same year.

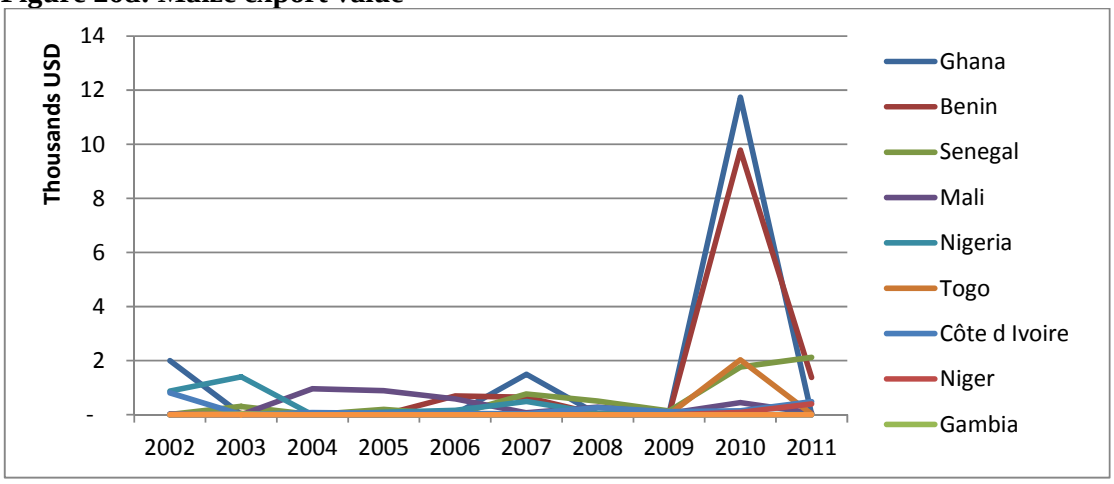
Figure 26c: Maize import trend for West Africa Region



Source: author (2014) calculated based on the Faostat (2013)

Generally the import value for maize is averagely low for countries within the West African region. Values range below 40, 000 USD. This clearly shows that, there is little dependence in maize by West Africa countries. It is expected that, the production capacity of maize in this region can be improved to enhance the trade-offs of dependency in rice and wheat. Considering the high global demand of maize for bio fuels, the regions less dependence on imports is an advantage to reduce its vulnerability.

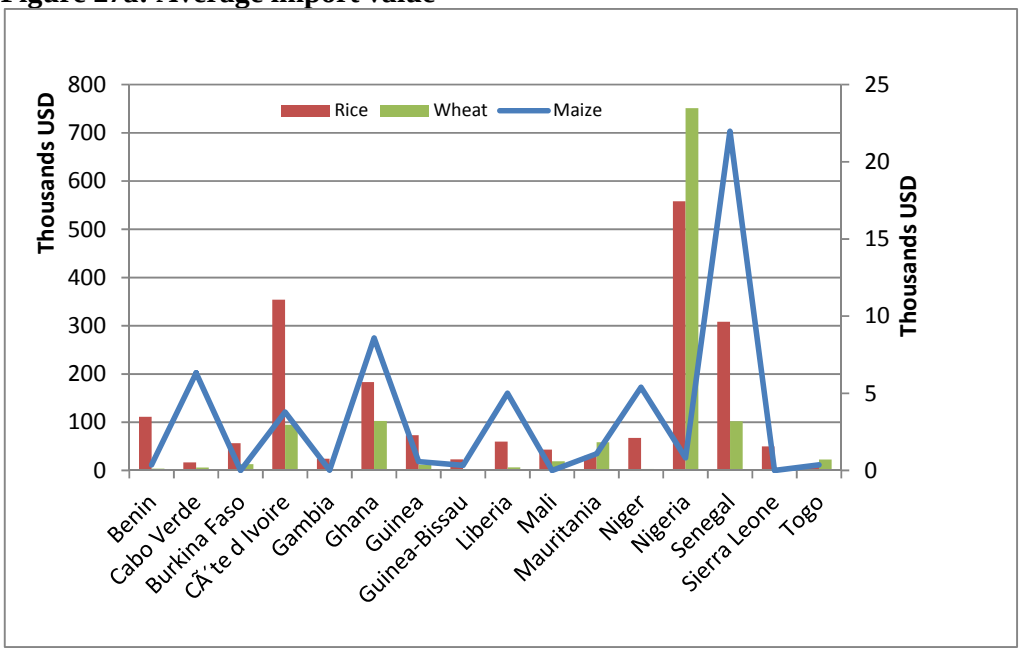
Figure 26d: Maize export value



Source: author (2014) calculated based on the Faostat (2013)

Comparatively, the countries listed in figure 26d are exporters of maize to countries within the region. Out of the 10 import countries presented in figure 26c; Cabo Verde, Liberia, Mauritania, and Guinea are excluded in the export figure. This reveals that they have less production capacity or imports to buffer their future stock. Mali and Togo are not reported as maize importers. Comparatively they are exporters within the region. This implies that their production capacity are sufficient, to support export to other countries in the region. Though export range is not as high, as that of the other regions of the world, the export capacity, when improved through production could enhance the regions resilience in maize, and enhance the trade-off other imported grains. It is interesting to note that Senegal, Ghana, CÃ´te d Ivoire and Niger import to subsequently supplement their export to other countries in the region and beyond.

Figure 27a: Average import value



Source: author (2014) calculated based on the Faostat (2013)

The average import value (figure 27a) shows that rice is the highest imported grain for most West African countries. This is followed by wheat and maize. Maize import on the other hand is low with an average range below 30,000 USD.

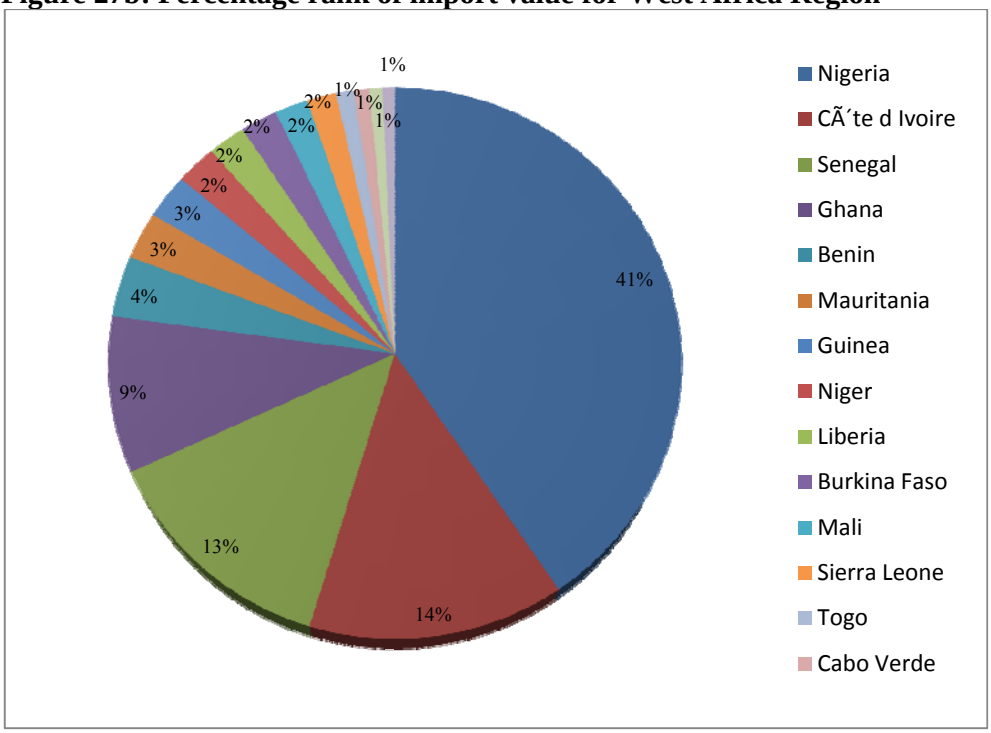
Nigeria's aggregate average for wheat, rice and maize is the highest in the region. CÃ´te d Ivoire, Senegal, Ghana and Benin follows subsequently in rank. On the basis of population, Ghana is expected to import more than CÃ´te d Ivoire, whilst Niger, Burkina Faso and Mali are expected to import more than Senegal. However, from the data analysis, the average rice production of CÃ´te d Ivoire is higher than that of Ghana, this implies that CÃ´te d Ivoire's rice consumption for food and feed outweighs Ghana's rice consumption, meanwhile wheat consumption of Ghana is slightly higher than the consumption of CÃ´te d Ivoire.

Furthermore, in the comparison of Senegal to Niger and Burkina Faso; the average rice production of Niger and Burkina Faso are lower than that of Senegal, coupled with their higher populations, it is then expected that, their imports should outweigh the imports of Senegal.

In addition, Mali's 1st and 3rd position in wheat and rice production volumes implies that its imports should be less compared to other countries. Consequently, Mali occupy's the 5th least position in aggregate imports.

In figure 27b the percentage rank of West African countries reveals that Nigeria consumes almost half of the regions grain imports. Whilst the total percentage import consumption of the 5 major import countries, CÃ´te d Ivoire, Senegal, Ghana and Benin constitute 77% of total imports. This shows the dependency of these countries and their vulnerability to grain security in the region.

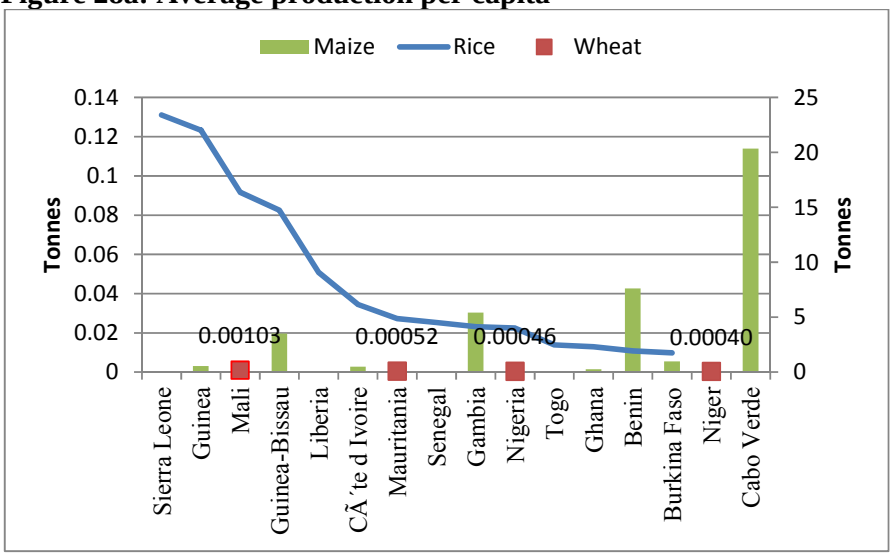
Figure 27b: Percentage rank of import value for West Africa Region



Source: author (2014) calculated based on the Faostat (2013)

Interestingly, Mauritania has the 4th least population size, and it is the 6th highest import country in the region. It can be implied that its grain consumption is higher than the other major importers of the region.

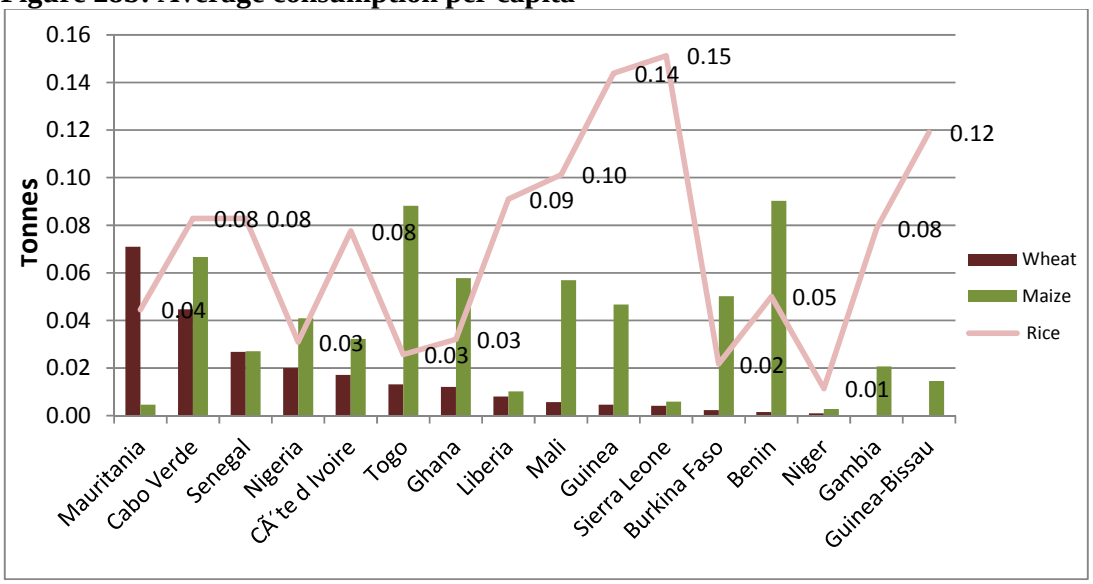
Figure 28a: Average production per capita



Source: author (2014) calculated based on the Faostat (2013)

The average production in the region is high for maize, compared to rice and wheat. In addition Sierra Leone, Guinea and Mali have the highest production per capita compared to Nigeria and Guinea which have the highest average production volume. Mali's position as the 3rd highest per capita producer for rice complements its 3rd position for average production volume. Niger has 0.00 tonnes of average production per capita, which accounts for its import value as the 7th highest rice importer in the region.

Figure 28b: Average consumption per capita



Source: author (2014) calculated based on the Faostat (2013)

In the analysis of average consumption per capita (figure 28b), Benin and Togo have the highest consumption per capita in maize, whilst Mauritania has the highest consumption per capita in wheat, followed by Cabo Verde, Senegal, and Nigeria, despite Nigeria's highest import value. Sierra Leone is the leading per capita consumer for rice, followed by Guinea and Guinea-Bissau, Mali and Liberia.

The least consuming countries per capita with an average of 0. 01 tonnes are Niger, Mauritania, Sierra Leone, Liberia and Guinea Bissau in maize. Niger, Sierra Leone, Guinea, Guinea-Bissau, Benin, and Burkina Faso have least consumption with an average of 0.00 tonnes for wheat, whilst Niger, Burkina Faso, Togo, Nigeria and Ghana have the least consumption in rice with average tonnes of 0.03. It is interesting to note that Niger has very low consumption in wheat, despite being the highest wheat producer.

In sum, Mali, Burkina Faso, Niger, and Togo are countries that are self reliant in consumption and production of grains in the region. They have low consumption per capita and have high production per capita, and have a lower import ranking. Togo, Niger and Mali are also exporters of maize in the region.

Summary of lessons learnt

Africa is the least contributor to world exports and is the second highest importer in rice and wheat for domestic consumption in the world. Relating this characteristic to stopper's assertion, that a successful country must have its export share higher than its share of trade (Storper, 1992).

In Africa, West Africa has a high consumption of wheat and rice, after North Africa.

The dependency of West Africa is in wheat and rice to supplement its domestic consumption, implies that there is a long term food security concern, which affirms Demont, (2002) argument that a country or region must be built on increased agriculture investments in increasing productivity and quality, value addition and branding.

4.1.5.1 Source countries and ties for the West African Region

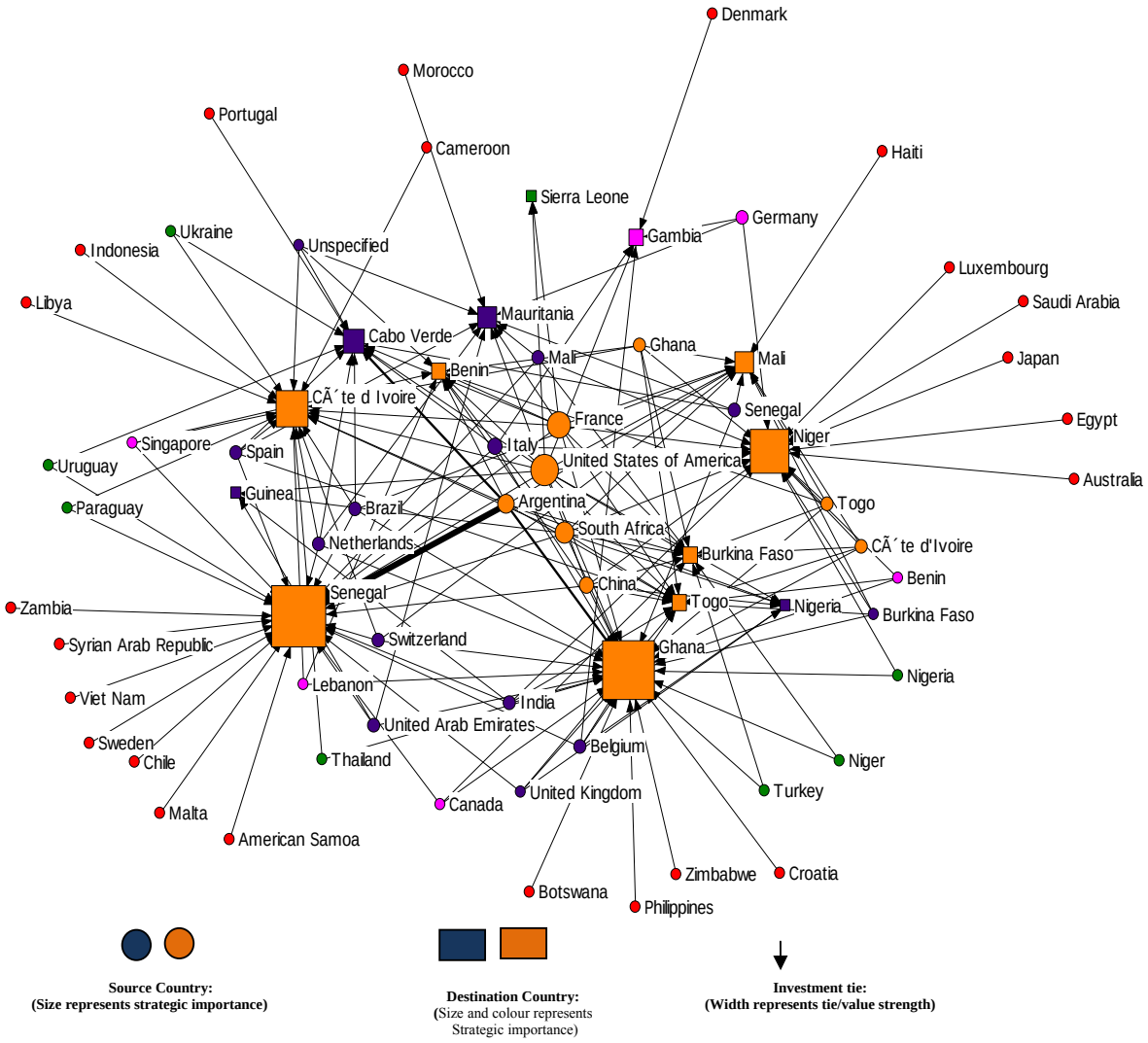
Structure linkages of maize import (source and ties)

The centrality measures revealed that United States, France, South Africa and India, including Argentina and China are important centres to West African maize imports. Their strategic position in the network for the region reveals that West African maize security is dependent on them.

However Argentina's investment tie/value is weighted high for destination countries of Senegal, Ghana, Niger, CÃ´te d Ivoire, Mali and Burkina Faso, including Benin and Cabo Verde. These West African countries are also strategically connected in the network of maize import, and therefore, are key to the network system in maize security of their neighbouring West African countries.

Structure linkages of rice import (source and ties)

Figure 29: Maize dependency network



Source: author (2014) network analysis based on the Faostat (2013)

Additionally, the closeness measure revealed that; Ghana, Netherland, Spain, Togo, and United Arab Emirates are important trade nodes. Their closeness to other important nodes in the network positions them in a strategic position for maize trade.

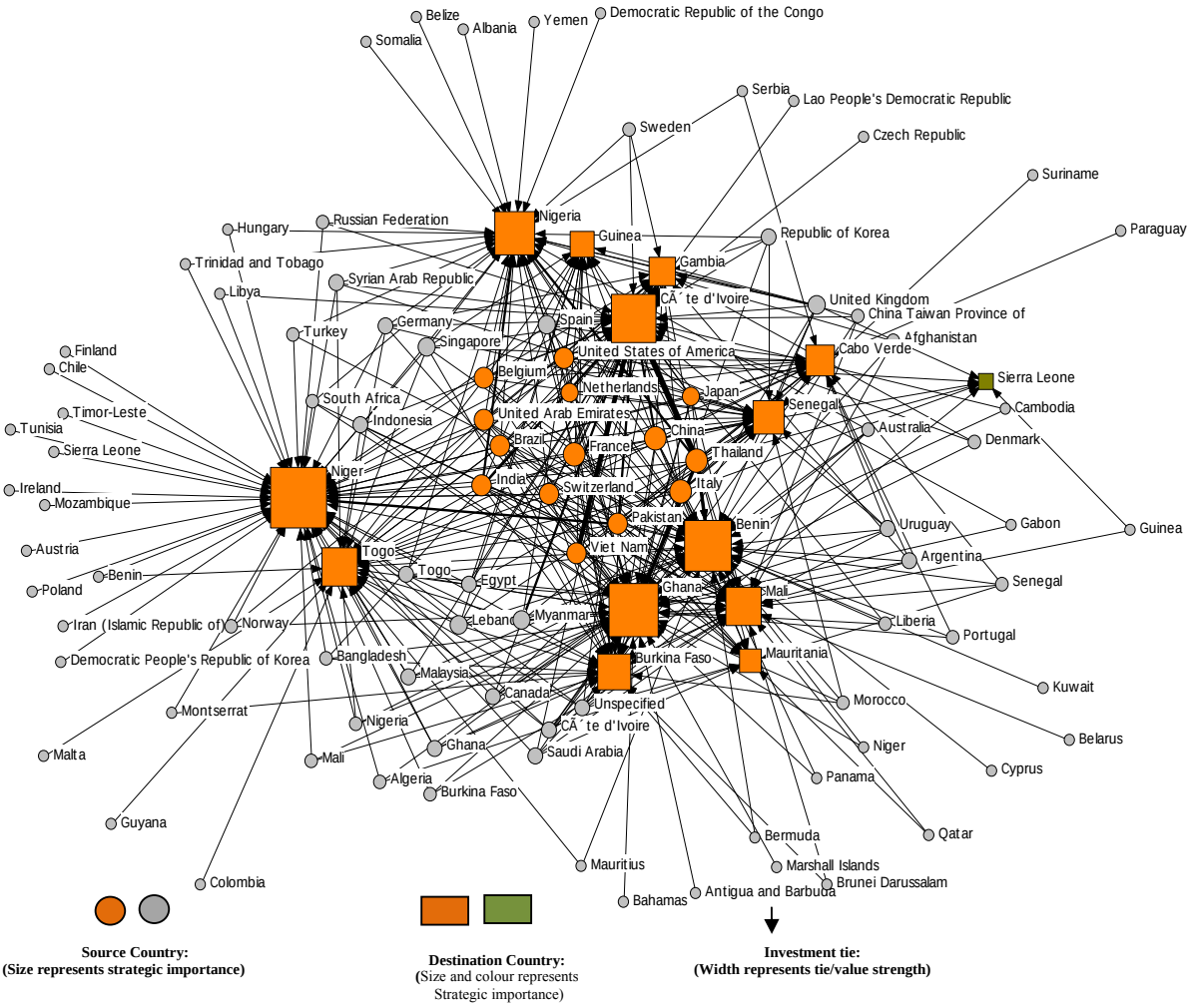
Furthermore, the network diagram shown in figure 29 reveals that Botswana, Chile, Argentina, Belgium and Canada, including America Samoa, Cameroon and Brazil occupy a very important position in the system. Their closeness to important source nodes such as United States, France, South Africa, India, and China makes their position important. The intermediary role occupied by Argentina, Cameroon, and CÃ´te d Ivoire gives a competitive advantage to their strategic positions in the network system.

The intermediary countries connect different country nodes in the network by offering the shortest path possible for trade and investment in maize. Other countries considered in the

category of the intermediary nodes include Benin, Burkina Faso and Belgium. The region's Inter regional trading partners such as CÃ´te d Ivoire, Ghana, Togo and Benin are contributors to the share of maize export to the rest of the region.

Structure linkages of rice import (source and ties)

Figure 30: Rice dependency network



Source: author (2014) network analysis based on the Faostat (2013)

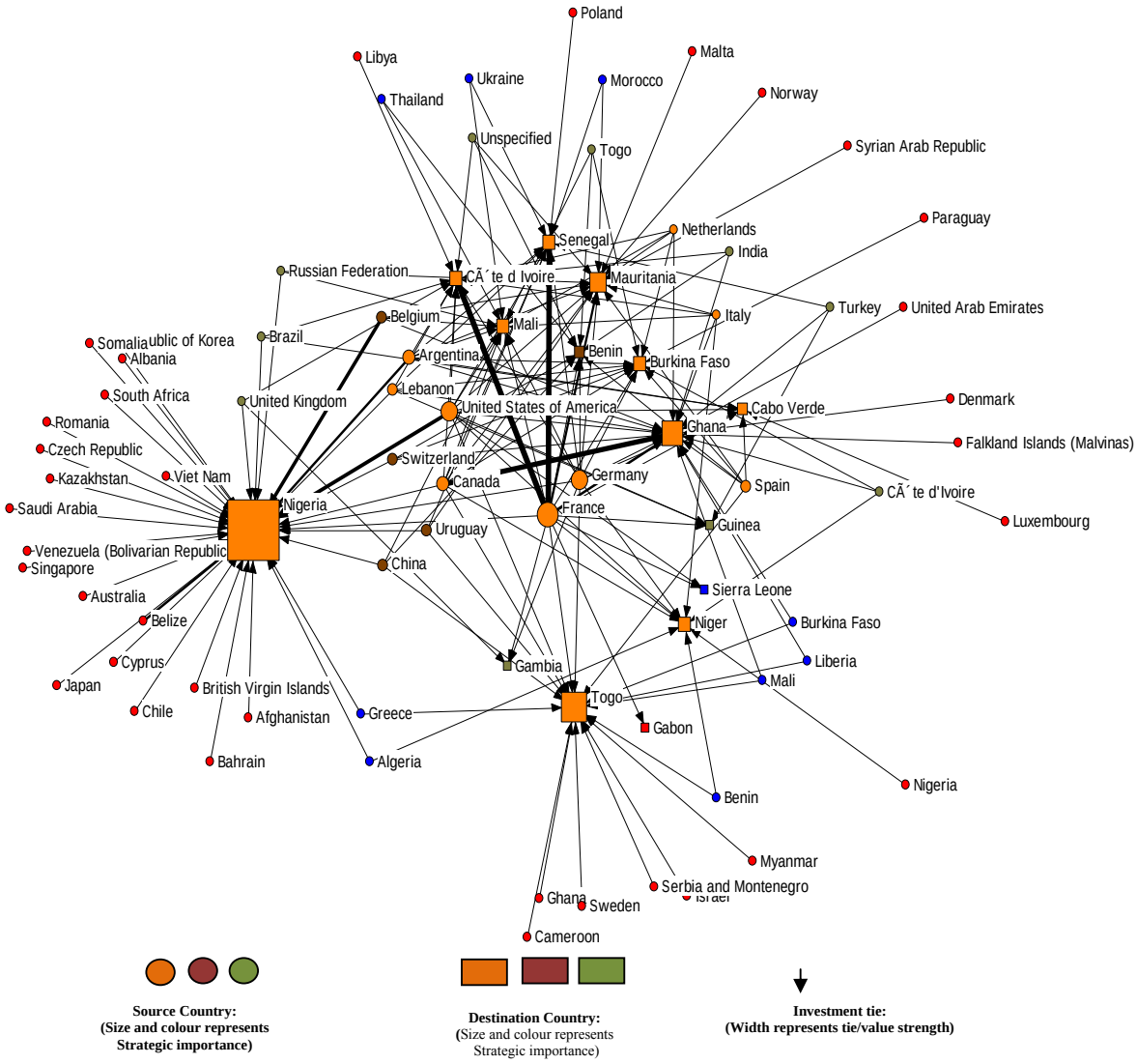
Figure 30 shows the connectedness and cluster structure of West Africa region to it source nodes in rice import. The ties between West Africa region and its partner countries such as Thailand, Vietnam, United States, Pakistan and Italy reveal its dependency considering the rice production levels in the region.

The centrality measure analysis revealed that Thailand, Vietnam, United States and Belgium among the other countries shown in figure 30 are central to the rice network of West Africa region. These countries further represent the command centres for rice export into the region and as such their withdrawer of export into the region may stimulate rice insecurity.

Sierra Leone's farness and less connectedness in the region's rice network is explained by its production per capita.

Structure linkages of wheat import (source and ties)

Figure 31: Wheat dependency network



Source: author (2014) network analysis based on the Faostat (2013)

France, Canada, United States and Germany form the strongest cluster and source centres for most West African countries. The strategic position of these countries including Argentina and Lebanon are critical nodes central to the network of the region. Benin's linkage in the cluster of Switzerland, Belgium, Uruguay and China reveals a second level cluster for the region.

The closeness of these countries to the strongest cluster and source centres positions them strategically as intermediaries to other parts of the network. Similarly Gambia and Guinea are also engaged in other structure linkages.

Burkina Faso, Benin and CÃ´te d Ivoire has higher degree of import linkages and are strategically position in proximity to important wheat export nodes. These countries as a result of their position are better position to improve their intermediary role and importance in West Africa wheat network.

In sum wheat consumption is an important staple in the global food basket. It is also an important determiner of international price of other grains. As a result, an analysis of the impact of location and production indicators is studied. This is done to ascertain the impact on export, import and production output, and to explain the relationship of such indicators on grain import dependency and the subsequent implication to grain optimisation and food security. The result is expected to set a benchmark for future analysis of rice and maize.

4.2 Explanatory analysis

This session focused on the effect of production and location indicators on regional export, import and production output of wheat. It used the deterministic (Pooled OLS regression) to the fixed effect model and the random effect model. This was done to test the robustness of the indicators modelled. The effect analysis was structured into four category; the world, major importers and exporters, Africa and West Africa. This is done in order to study the drivers of import from the world, Africa and West Africa perspectives, and to understand the indicators that leads to excellence from major exporters and importers who are contributors to world trade. The Hausman test run to identify which model best interpreted the results. The test indicated the fixed effect model as the appropriate.

4.2.1 Production and Location factors as determinant of grain import

4.2.1.1 Production factors as determinants for grain optimisation

World Analysis

- The results below present the variables in the order of importance and impact. The result revealed that production quantity is inversely correlated with import and positively correlated with export. This implies that export increases with increase in production whilst import reduces with increase in production. Population corresponded positively to import and production quantity, but inversely correlated with export. This explains that, population increase is a stimulus to export reduction in exporting countries, but results in import increase for import dependent countries.

Table 9: Fixed effect analysis of production variables to import, export and production quantity

Import value	Fixed effects
Population	0.01***
	(0.00)
ProdQtyTonnes	-0.02***
	(0.00)
Constant	-163.72***
	(58.64)
Observations 1219	(R^2=0.04), F (25.04) P < 0.001

Dependent Variable: Import value
*{Standard errors in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01}*

Export value	Fixed effects
ProdQtyTonnes	0.06***
	(0.01)
Population	-0.01
	0.00
ProdPriceIndex	825.42***
	(196.35)
Constant	70.02
	(227.52)
Observations 803	R^2= (0.55), F (334.35) P < 0.001

Dependent Variable: Export value
*{Standard errors in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01}*

Production quantity	Fixed effects (FE)
Population	0.10***
	(0.02)
YieldHgperHa	95.88***
	(10.26)
AgriLand	14.67
	(23.59)
Constant	-2848.14*
	(1031.68)
Observations 1207 (R^2=0.57), F (525.22), P < 0.001	

Dependent Variable: ProdQtyTonnes
*{Standard errors in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01}*

Source: author (2014) model analysis

The results confirm that increasing population presents a challenge of feeding the world hence the concern for food security (Godfray et al., 2010). The analysis also revealed that production quantities are expected to increase with a rise in population. However, the general effect is that as population increases, more investment in production is expected in order to ensure optimal production capacity to feed the growing demand. However, such an effect is relative, considering the unique characteristics of countries such as the participation of well educated and trained workforce in agriculture, which are skilful at absorbing new production technologies to increase yield, which consequently increases the production quantities.

Yield per hectare has a significant impact on production quantity. This implies that as yield increase, production quantity increases. Producer price index also serves as a stimulus to growing export. It shows that as price index are raised, the percentage profit from export increase, since producers get value for their money and are encourage producing more.
Agriculture production factors have significant impact on production quantity at 57% and export value at 55%. This explains that for grain production to be optimised, the advantage the factors of production such as yield, quantity produced, and price in addition to increase demand are necessary input that should be improved.

4.2.1.2 Location factors (12 Competiveness Pillar) as determinant of Production, import and export levels of the world

A country's rank in location factors measure its attractiveness to investment opportunities, and the rate of return on such investment. It also determines the extent of its resilience to challenging phenomenon.

The regression analysis revealed that location factors determine 21% of grain export, 38% of grain import and 40% of grain production. Market size and labour market efficiency were significant to all three dependent variables. Market size, technological readiness and labour market efficiency has 40% impact on grain production. Other factors which impacted on import include macro-economic environment and institutional ability. Institutional ability

predicted an 8% impact on production, a 20% impact on import and a 23% impact on export activities.

The labour market efficiency allows flexibility and incentive for labour to shift from one economic sector to the other; such as a shift into the agriculture sector without wage fluctuation is critical to optimising world grain production. The fixed effect result of labour market was inversely correlated to import, but positively correlated to production. This implies that a vibrant labour market will reduce import and increase export, thereby enhancing economic growth and flexibility in employment opportunities.

The reliance on professional management and the effect of taxes on agriculture imput are critical at reducing import and optimising production. The size of both domestic and foreign market has effect on the incentive to optimise production. Though it has been established in previous chapters that trade stimulates a country's growth, but the extent of dependence on import has impact on its share of vulnerability to food security. It is important to manage a country's market size with robust economic measures in order to enhance the economies of scale in trade.

4.2.1.3 Characteristics of Institutional ability, Infrastructure and Knowledge capital to optimal grain production and import

Institutional ability

The analysis of institutional ability studied the role of institutions in enhancing an environment of improved grain production and reduced import vulnerability. The sub indicators for this factor combined sub indicators of institution (pillar 1), goods market efficiency (pillar 5), labour market efficiency (pillar 7) and market size (pillar 10) from GCI.

The selected indicators for institutions, infrastructure and knowledge capital in chapter 3 (table 4) were modelled using the fixed effect. However the multiple regression results of the selected variables showed that institutions have an R^2= (0.34), F = (184.83) $p < 0.01$; infrastructure has an R^2= (0.02), F = (6.84) $p < 0.01$ and Knowledge capital has an R^2= (0.08), F = (8.51) $p < 0.01$.

The fixed effect is shown in table 9 below:

Table 10: Fixed effect analysis for grain optimisation

Institutions	FE	Infrastructure	FE	Knowledge capital	FE
10.01Domesticmarketsize	327.90 (387.13)	2.04 Quality of port infrastructure	64.40 (223.51)	12.04Universityindustryco	712.74*** (234.22)
9.01 Availability of latest technologies	444.70** (157.90)	2.08 Mobile telephone subscriptions/100 pop.	6.90* (3.02)	Constant	3631263*** (845233.6)
Constant	2843962 (1930752)	Constant	5375101.17*** (848679.93)		
Observations (708)		*observations (708)*		*observations (708)*	

Dependent Variable: ProdQtyTonnes *{Standard errors in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01}*

Source: author (2014) model analysis

This implies that the role of institution is critical, because it has a 34% impact to optimize production, whilst infrastructure and knowledge capital complement the optimization of production with 2% and 8% respectively.

The regression results showed that the predictor variables in table 6 are all significant to increasing production. However the fixed effect results showed that availability of latest technologies and mobile telephone subscription are significant and have a positive impact to increasing production. Implying that as the availability and use of technology and the access to communication through mobile telephone increases, production also increases. This confirms the argument by Malecki (2002), that mobile telephone and sharing of knowledge through mobile telephone enhances knowledge acquisition and assimilation from external source. The author termed this essential to enhance creativity and economic growth (Malecki, 2002).

The fixed effect analysis on import and export revealed an inverse correlation between import and reliance on professional management, whilst it showed a positive and significant correlation to availability of latest technology.

Generally the results indicate that for a country to move up the value chain in production and trade (export and import); it is critical that it improves its competitive policies that optimises the reliance on professional management and enhance best available and friendly technologies for its production.

Infrastructure

The analysis of sub indicators of infrastructure (pillar 2) from GCI revealed a 5% impact on export, 2% impact on production quantity and 2% impact on import. Quality of port infrastructure and mobile phone subscription were significant at 1% for production.

With the multiple regressions, results showed that export value correlate with quality of electricity supply, whilst the fixed effect showed a positive and significant correlation to mobile phone subscription.

Import correlated positively to quality of road and electricity. The fixed result showed an inverse relation between quality of electricity and import. It is explained that as quality of electricity improves, productivity increases, thereby enhancing food availability and reducing import volumes.

Knowledge capital

This variable combined selected sub indicators of pillar 4, 5, 9 and 12 of GCI. Knowledge capital has a 13% impact on export, 7% impact on import and 8% impact on production quantity. Production quantity is influenced by individuals using internet whilst the availability of scientist and engineers has priority significance to all production and import.

Quality of scientific research institutions and Firm level absorption is significant to export, whilst the availability of scientist and individuals using internet correlated inversely to import.

The table below summarises knowledge impact on import

Table 11: Fixed effect analysis for import reduction

Import	Pooled OLS	Fixed Effect
12.06 Availability of scientists and engineers,	170.51*** (22.31)	-77.02** (28.58)
9.04 Individuals using Internet, %	-56.98*** (15.21)	-0.03*** (0.01)
Constant	-425.47*** (94.21)	608.75 (120.08)
Observations 759, R^2= (0.07), F=(30.27)		

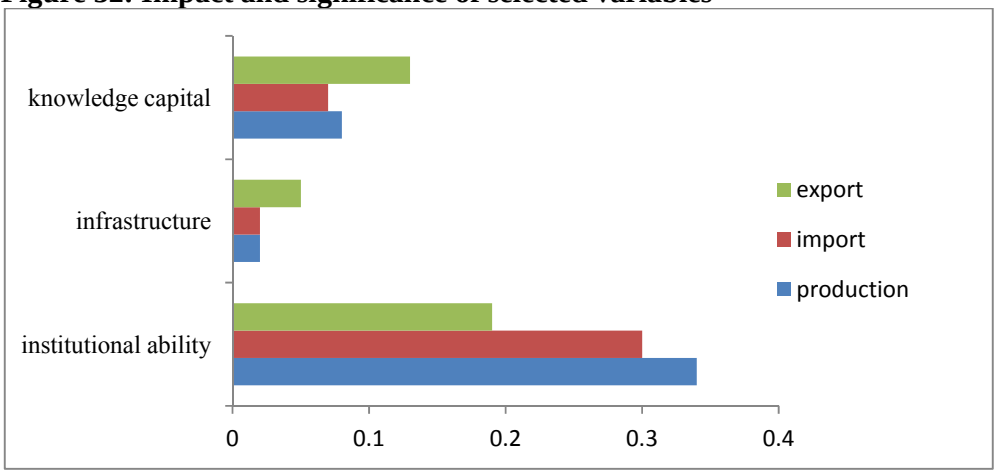
*Dependent Variable: Import {Standard errors in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01}*

Source: author (2014) model analysis

The accessibility and ease to information and technology influenced by internet infrastructure is seen to have an impact on import. It can be explained that, communication on production techniques continue to evolve, and as such, staying in touch and receiving information is key towards the realisation of optimal production and cost effectiveness. As production quantity and quality improves for a region, import dependence reduces, whilst export and other investment opportunities also improves. This phenomenon will invariably have positive impact on food security

Figure 32 summaries the above analysis to imply that, institutions have a role to play in enhancing production and reducing the effect on import. The available level of knowledge and the human capital stock is complementary to the role played by institutions to improve a regions output and reduce its vulnerability.

Figure 32: Impact and significance of selected variables



Source: author (2014) calculation based on model analysis

4.2.1.4 Characteristics of FDI to Import, Export and Grain Production

The value and number of investment predicts a significant impact on import, export and production. FDI investment discussed within the context of exporting knowledge and resources in production implies that a reduction in the frequency and value of country's interaction reduces the potential of grain export, import and production.

The regression analysis revealed that the value of FDI ties is highly significant to grain import and production potentials, whilst the number of county to country interactions (FDI) is significant and positively related to export.

Table 12: Fixed effect analysis of FDI to import, export and production

	Import (FE)	Export (FE)	Production (FE)
FDI valued	2.94*	6.01**	-11.59
	(1.56)	(2.97)	(13.63)
FDI numbered	62.24	866.36***	1849.83**
	(77.67)	(146.89)	(727.72)
Constant	244835.30***	142637.25***	6048158.33***
	(11543.68)	(23063.25)	(114128.55)

*{Standard errors in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01}*

Source: author (2014) model analysis

Within the context of trade, as the value of FDI rises, imports increase proportionally. Meanwhile exports increases with the number of linkages a country have, in addition to its value in the interactions. This enhances the percentage profit and economies of scale of the export country or firm. However production reveals that the number and frequency of interaction is important; as knowledge capital shared through collaboration and the frequency of interaction promotes productivity, hence will improve production output.

4.2.1.5 Location factors as determinants of Export, Import and Production

Location indicators[7] determine the potential of a country to improve its resilience and competitiveness in world trade. From the fixed effect model analysis, foreign market size[8] and production process sophistication were significant and positively related to import.

Domestic market size was expected to have a positive correlation with import, however foreign market size was significant and positively correlated. Foreign market size is defined as the value of a country's export of goods and services. The positive correlation can be explained that this indicator represents countries that are involved in secondary and tertiary industries, and not primary production. Therefore as the value of their export of goods and services increases, it could be inferred that their import value also increases. In addition it can be explained that the import of major exporters and producer are to supplement their export volumes to demand areas. It could be inferred that the major driver of import is the increase in both foreign and domestic demand areas.

As production process sophistication increase, import also increases, due to consumer taste and preference toward such product. This is evident in West Africa's import for perfumed rice as against the less sophisticated production processes for rice grown locally.

[7] Location indicators: variables defined by the Global competitive index (pillar 1 to 12). Refer to annex

[8] Foreign market size: value of exports of goods and services

Table 13: Model analysis of predictor indicators to world import

Import (dependent)	Pooled OLS	Fixed effects	Random Effects
10.02 Foreign market size index,	223.45***	124.17***	181.38***
	(18.24)	(33.86)	(23.45)
5.06 Internet access in schools,	-112.43***	-12.60	-53.88*
	(25.33)	(29.35)	(25.65)
3.04 General government debt, %	3.43***	-0.32	0.72
	(0.50)	(0.60)	(0.51)
1.12 Transparency of government policymaking,	-75.64**	-14.20	-33.11
	(29.50)	(32.80)	(28.62)
6.10 Trade tariffs, %	8.83**	0.70	3.07
	(3.20)	(2.30)	(2.20)
11.07 Production process sophistication,	148.75***	58.57*	83.63*
	(34.61)	(46.71)	(36.23)
2.09 Fixed telephone lines/100 pop.	-4.12***	-0.51	-2.97
	(1.43)	(2.50)	(1.66)
Constant	-585424.46***	-331440.03	-434605.29**
	(114922.31)	(223193.68)	(137178.34)
Observation (671),(R^2=0.36)	136 countries		

Dependent Variable: Import *{Standard errors in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01}*

Foreign market size, available airline seat and FDI and technology transfer showed significance and were correlated positively to production.

This implies that as foreign market size increase, production increases to complement demand. In addition as there are available airline seat, it stimulate easy movement of services and decision making whilst the transfer of technology and FDI improve and increase production quality and quantity.

Available airline seat showed a positive relation to export, which implies that movement of services, decisions and general communication increases the frequency of interaction and export. This could be in the form of knowledge, expertise, goods and services.

4.2.1.6 Characteristics of major importers and exporters

The characteristic of major importers to the location factor revealed that the state of cluster development has a positive relation and significance with import. The result [9] implies that import increases with the state of cluster development. It is inferred that with current production in value chains, major importers import raw and semi finished grains to process into finished goods which is further exported. The more cluster occurs through value chain, import of raw and semi processed grains will increase.

The number of procedures to start a business was inversely related to export, whilst available airline seat positively related to export. The increase in the number of procedures or barriers,

[9] Results: refer to annex 3 for table result of major importers and exporters

a country or firm needs in order to start a trade relation with another serves as a disincentive to such trade engagement hence reduces export relation. Available air line seat ensures the easy movement of services and communication among partners.

The above characteristics indicate that communication, business procedures and state of cluster development are the significant characteristics that impact on opportunities of export and import relation of major export and import countries.

4.2.1.7 Location factors as determinant to import in Africa

Results show an inverse relation between import and research and development investment in agriculture by higher education. Location indicators significant to import in Africa are the soundness of bank, quality of scientific research institution and state of cluster development.

The inverse relation of research and development investment by higher education means that an increase in investment into agriculture sector by higher education institutions results in innovation and increase quality and quantity to satisfy domestic demand, thereby reducing import.

Soundness of bank and quality of scientific research institution showed an inverse relation. Annual percentage change of inflation, real interest rate, and credit rating of a countries banking system represented through its soundness of the bank system has impact on import value. A higher soundness of the bank systems reduces the purchasing power parity in the international dollar equivalence, hence reduce import value. A reduction in the soundness of the bank system increases the parity between the international dollars. This reduces the purchasing power and thereby increases import value.
The inverse relation of the quality of scientific research institution to import shows that as the quality of the research institution into agriculture improves the innovation of high yield and weather resistant seeds and plant. This leads to production of high yield and quality crops. It also increase supply quantity, reduce import and increase export and improve stock quantity.

State of cluster development showed a positive relationship and significance to import. Africa's position in the value chain of cluster development is in consumption and export of raw or semi processed grain. In that regard, as its state of cluster development or partnership increases, the import of grain-related finished product also increases, thereby increasing import.

Table 14: Model analysis of Africa region's import indicators

Import value	Pooled OLS	Fixed effects	Random Effects
Production factors	*(observation 178)*		
RnDInvst_HighEdu	617.78*** (58.79)	-2928.42*** (450.35)	774.13*** (102.34)
Population	.001*** (.000)	0.00 (0.00)	0.00 (0.00)
TractorImpVal1000USD	.283*** (.07)	0.01 (0.06)	0.24*** (0.07)
(Constant)	-814.22*** (4002.41)	-153359.63*** (41017.59)	-2908.90 (7252.77)
R^2 (0.86), F (357.35)			
Location factor			
10.01 Domestic market size index,	155.11*** (13.94)	19.24 (31.58)	130.80*** (17.67)
8.06 Soundness of banks,	-119.70*** (18.91)	-52.58* (27.80)	-92.97*** (21.64)
11.03 State of cluster development,	137.61*** (24.63)	65.10* (33.21)	135.59*** (28.12)
2.07 Quality of electricity supply,	-89.20*** (11.83)	-31.62 (19.44)	-68.03*** (14.18)
3.02 Gross national savings, %	2.51** (0.86)	0.56 (1.09)	2.15* (0.94)
2.04 Quality of port infrastructure,	66.67*** (14.07)	30.30 (20.26)	57.08*** (15.57)
12.02 Quality of scientific research institutions,	-96.10*** (21.90)	-98.49** (35.08)	-78.05** (25.95)
6.12 Business impact of rules on FDI,	63.94** (19.62)	19.67 (31.38)	36.34 (23.40)
4.10 Primary education enrollment, net %	-2.13** (0.70)	0.27 (1.16)	-1.28 (0.85)
9.04 Individuals using Internet, %	-0.18** (0.06)	-0.06 (0.06)	-0.14* (0.06)
6.16 Buyer sophistication,	80.87** (26.70)	6.54 (36.10)	46.31 (29.52)
(Constant)	-122.75 (87.18)	330.96 (271.48)	-115.07 (125.96)
Observations 147, R^2 (0.78) (F (43.58) P < 0.01			

Dependent Variable: Import Value {Standard errors in parentheses $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$}

Source: author (2014) model analysis

4.2.1.8 Location factors as determinant of grain import for West Africa

Table 15: Model analysis for West Africa regions wheat import indicators

Wheat	Pooled OLS	Fixed effects	Random Effects
Production factors *($R^2$0.89) F(234.69)*	*Observation (90)*		
Population	0.00*** (0.00)	0.03*** (0.00)	0.00*** (0.00)
TractorImpVal1000USD	0.32*** (0.12)	-0.13** (0.05)	0.28** (0.11)
(Constant) *F(234.69)*	27196.07*** (8339.74)	-502075.69*** (23614.81)	-53817.15*** (18398.35)
Location factors			
2.06 Available airline seat kms/week, millions	3.71*** (0.31)	4.44*** (0.64)	3.87*** (0.41)
12.02 Quality of scientific research institutions,	-123.93*** (26.17)	61.26 (68.12)	-45.15 (37.53)
10.01 Domestic market size index,	71.31* (29.25)	21.65 (51.74)	18.75 (32.40)
9.02 Firm-level technology absorption,	-72.35* (30.40)	-18.42 (34.63)	-40.87 (31.45)
Constant	505.47** (179.56)	-256.52 (347.15)	229.23 (212.20)
Observations 51, (R^2 0.90) F (106.34)			

Dependent Variable: Import Value {Standard errors in parentheses *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$}

Source: author (2014) model analysis

Population and tractor import value showed a positive and significant relation to import. The increase in population, results in increase demand. The supply deficit in demand of grains for West Africa implies that import will have to increase to supplement supply deficit.

The impact of tractor import value on import shows that a unit increase in tractor import value results in an increase in import value. As farming machinery is important in improving production quantities, an increase in its value affect production cost. The high production cost imputed into producer price has an impact on the percentage change in the product value. This intends impact on import value ratio. Hence, a high import value. As a result import reduces overtime with high machinery import value, as revealed by the inverse relation from the fixed effect model.

An increase in availability of air line seat showed an increase in import, this is because; easy movement across supply areas is enhanced. The easy movement enhances decision making concerning the preferred choice and taste of grain product imported.

Table 16: Model analysis for West Africa regions rice import indicators

	Pooled OLS	Fixed effects	Random Effects
Production factors (Rice)	*Observation (150)*		
($R^2$0.77) F (171.59)			
Population	0.00***	0.02***	0.00***
	(0.00)	(0.00)	(0.00)
YieldHgperHa	-2.95***	0.03	-1.16
	(0.85)	(1.27)	(1.17)
(Constant)	-38.121.27*	-259964.33***	-72457.92**
	(20088.76)	(47666.31)	(32253.54)
Location factors			
2.06 Available airline seat kms/week, millions	2.75***	5.15***	3.04***
	(0.29)	(0.66)	(0.44)
2.04 Quality of port infrastructure,	56.57*	-15.77	29.67
	(21.77)	(26.10)	(25.64)
12.04 University-industry collaboration in R&D,	-193.90***	-93.11	-145.68***
	(42.28)	(47.04)	(43.83)
5.07 Availability of research and training services,	170.46***	-165.33*	170.24**
	(39.00)	(79.89)	(52.06)
1.08 Wastefulness of government spending,	-67.51*	-52.71	-65.33
	(25.33)	(47.44)	(33.91)
Constant	20.78	-160.70	-35.42
	(115.06)	(155.47)	(146.77)
Observations 51, (R^2 0.88) F(54.53)			

Dependent variable: Import Value {Standard errors in parentheses *p < 0.10, **p < 0.05, *** p < 0.01}

Source: author (2014) model analysis

Furthermore, the fixed effect result shows that availability of research and training services has significant impact to reduce import. This is because the increase in research and training services for the region will increase the capacity of farmers and agriculture entrepreneurs to improve their productivity. In addition training on production and processing will improve quality and value addition. Consequently, it will enhance the satisfaction of taste and preference demand of domestic consumers.

4.2.1.8 Learning from the location characteristics and focus areas of improvement

Several location factors have proved to be significant to production and import reduction from the world scale through to the regional scale. Characteristics of major export, import and producing countries comprise the role of government and institutions to undertake sound

economic policies in addition to infrastructure improvement and the enhancement of knowledge environment that stimulate the growth process.

The characteristics of West Africa import indicators have also presented the study with indicators that drive import. Indicators for further improvement and their significant impact on reducing and or driving import and production have been categorised under orgware (institutional ability), hardware (infrastructure) and software (knowledge capital). Table 16 below shows the indicators for improvement.

Table 17: Summary of indicators for improvement

	Role of institution	**Infrastructure**	**Knowledge capital**
Import reduction and indicators for optimal grain production →	State of cluster development Soundness of banks Reliance on professional management Extent and effect of taxation Availability of latest technology Number of days to start a business	Fixed telephone lines/100 pop. Quality of electricity supply, Mobile telephone subscriptions/100 pop Individuals using Internet, % Available airline seat kms/week, millions	Availability of scientists and engineers Quality of scientific research Availability of research and training services, Production process sophistication University-industry collaboration in R&D FDI and technology transfer RnD investment by higher education in agriculture

Source: author (2014) model analysis

The multiple regression analysis of the above indicators revealed that knowledge capital indicators will have a 40% impact in reducing import and a 13% impact in improving production quantity for the West Africa region. However this indicator revealed an impact of 9% on world import and production. Results also revealed that improved production process sophistication is very significant to reducing import of West Africa.

Infrastructure indicators showed a 27% and 23% impact on production and import respectively for West Africa whilst a 3% and 2% impact on production and import is predicted for the world. This result excludes availability of airline seat since it is a predictor that has significant impact on the results of infrastructure. It predicts 31% significance to production and 4% significance on import for the world, whilst it contributes 70% and 65% on production and import respectively for West Africa.

Finally institutional ability showed an influence on import by 25% and on production by 44% for the West Africa region, whilst a 9% impact on production and 16% impact on import for the world.

From the above impact analysis, it is noted that state of cluster development and soundness of the bank were key indicators which have a strong influence on optimal production, whilst state of cluster development and reliance on professional management are central to reducing import vulnerability.

The above result implies that the higher the soundness of the bank system and the reliance on professional creativity and management, including the network clusters for knowledge sharing and production process sharing , the higher the potential for optimal production and reduction in import vulnerability for the West Africa region.

Chapter 5: Conclusions and recommendations

The final chapter presents a summary of the research and provides answers to the research questions posed for the study. The study results and its implications are stated in relation to the research objective and theory. The lessons learnt are highlighted within the context of regional resilience and grain optimisation. Additionally, the scope for further study is also proposed in this chapter.

5.1 Major findings and answering the research questions

Literature revealed that trade (import and export) is an integral part of economic development, however if it leads to dependency, such as widening the balance of payment deficits, then it becomes problematic (Hoering, 2013).

The study aimed to examine the factors that will reduce West Africa's import dependence for grains (maize, rice and wheat) and improve food security. It also aimed to understand grain imports growth over time and the characteristics of West Africa import dependent countries and their sources of supply, whilst examining the determining production and location factors of import and the factors that need improvement to enhance grain optimisation and food security for the region.

As noted Tadesse et al. (2013), and Godfray et al. (2010), the recent events characterising food security, such as the increasing demand for rice wheat and maize, the use of grains for feed and fuel, and the volatility in grain prices have resulted in several policy measures to surmount future vulnerability to food security.

The study proposed that the major economic reason to reducing dependency and vulnerability to imports is to build regional resilience that optimises domestic grain production.

The study performed the multiple regression analysis, fixed and random effect assessment on the agriculture production and location indicators to test the robustness of the results.

5.1.1 Answer to research sub question 1

Growth of imports

Q. What is the growth of imports over time for wheat, rice and maize in the world?

literature reviewed from Hoering, (2013) argued that trade (import and export) is integral to economic growth and development, however, importing becomes negative when it leads to widening balance of payment deficits and dependent source of supply to satisfy increasing demand. USDA, (2014) report indicated that the major drivers of increasing import are the developing nations of Asia and Africa. However, the ability of regions to anticipate, evolve and adapt to changing circumstances is what reflect the differences in regional economic growth and resilience (Pendall et al., 2010).

As stated by Storper (1992, p. 68) "*A country is successfully specialised in today's world economy when its share of world exports of a specific product is greater than its share of world trade as a whole (i.e., the share of a country's imports and exports as a share of total imports and exports of the world)"*.

Based on the reviewed literatures, the assessment of import growth over time was classified on category of major importers, exporters and producers of the world. This was done to determine the differences between regions that import for trading purposes and those who import to supplement domestic consumption.

Major importers: most of the major import countries are in Europe, North America, Asia and Africa. Whereas imports by Europe and North America are mainly for purposes of trade to boost economic growth, the imports of Asia and Africa are mainly consequence to supplement domestic food. North and West Africa are leaders in grain import.

Major Exporters: it was found that North America, Europe, Latin America and Asia are major suppliers to the rest of the world for maize, rice and wheat. Most maize exports are from North and Latin America, wheat from Europe and North America and rice from Asia and North America. For rice production, 5 countries from Asia and North America hold 50% of the world export. It was found that most of the major exporters of maize and rice from Europe are not major producers whilst others are non producers.

Major producers: Major producers of all three grains are from North America, Latin America and Asia, whilst major producers of wheat are from Europe. Asia is the major producers of rice whilst North America, Latin America and Asia are major maize producing region. It was found that most producers in Asia are also importers of grains. They import to supplement their consumption especially in rice and wheat.

Import dependence: majority of the countries in export are from Europe and North America. Whilst majority of importing countries are from West Africa, North Africa, and Asia. It was found that Latin America, Europe and North America import to complement export, whilst Africa's import contribute 9.1% to its domestic consumption. Comparing the African and Asian regions, it was found that Asia's domestic production outweighs its imports whilst Africa's imports outweigh its production. North and West Africa are the leading regions for import in Africa with 26.3% and 17.7% respectively.

Table18: Ratio of regional dependence

Region classification	Export (%)	Import (%)	Production (%)
Africa	0.9	13.8	3.8
Asia	19.4	34.2	59.6
Latin America and the Caribbean	15.2	19.0	6.0
Transition and Developed region (Europe, north America and Japan)	64.5	33.1	30.6

Source: author 2014, calculation based on FAO database

Interpretation of findings to literature

The finding of Africa and Asia as the leading drivers of imports corresponds and confirms USDA, (2014), Hoering (2013), Demont (2013) and Godfray et al., (2010) assertion that Asia and Africa are drivers of import. However, the extent to which Africa's food basket is filled with import for domestic consumption presents a challenge to governments of the region.

The 2008 food crises resulted to investment initiatives by governments of Africa to boost productivity. The implication is that productivity in grains can be easily improved within

Africa, however the increased preference biased towards imported rice and wheat related products confirm to a large extent Hoering (2013), assertion that trade and policy conditions from investment partners, and African governments interest of ensuring cheap food for its urban population have contributed to the import dependency of west africa and other regions of Africa.

The suggestion from Demont (2013) literature is to quality –dedifferentiate local from imported rice through value addition and to maintain the balance between productivity and affordability. The suggestion by Demont (2013) confirms the concept of grain optimisation and delocking potentials of knowledge capital (software), institutional ability (org ware) and infrastructure development (hard ware) to improve quality and enhance resilience to food insecurity.

5.1.2 Answer to research sub question 2

Import dependency of West Africa

Q. Which countries have higher import dependency in West Africa and which countries supply the West African region?

An analysis of the various countries within the West African region was undertaken based on consumption and production per capita and percentage contribution to import.

Import contribution: the analysis shows that Nigeria has the highest import of 41%, which is followed by CÃ´te d'Ivoire with 14%, Senegal with 13% and Ghana with 9% import contribution. The four (4) countries, out of the 15 countries in West Africa contribute 77% of average import value of the region. Benin and Mauritania contribute 4% and 3% to import respectively whilst the rest contribute 2% and 1% to the regions imports.

Consumption per capita: Sierra Leone, Guinea and Guinea Bissau, Mali and Liberia have high consumption per capita. However, despite Sierra Leone's high consumption ratio, it consumes its domestic rice production. This shows its resilience to rice import vulnerability. Mauritania, cabo Verde, Senegal, Nigeria and CÃ´te d'Ivoire have high consumption of wheat in West Africa whilst Benin, Togo, Cabo Verde, Ghana and Mali have high consumption in maize. Maize import for the region is very low. Out of the three grains, consumption per capita is high for rice, followed by wheat and maize. High import quantities in rice and wheat have been recorded for West African countries, however, maize import is insignificant to the import basket for the region.

Production per capita: Sierra Leone is self sufficient in rice production. It has the highest average per capita production. However, Nigeria has the highest production in volume, followed by Sierra Leone, CÃ´te d'Ivoire and Ghana. Guinea, Mali, Guinea Bissau, and Liberia are the highest per capita producers in the region. Wheat is produced in 4 countries out of the fifteen (15) countries.

The four wheat countries Mali, Niger, Nigeria and Mauritania have per capita of 0.00 tonnes. Maize production per capita is the highest for all three grains in the region. Average production per capita has a 20.4 tonnes for Cabo Verde. The highest recorded so far for per capita production in the region for rice, wheat and maize. Benin is the highest producer in volume, followed by Burkina and cabo Verde. However Benin and Gambia occupy the second and third positions in per capita production after Cabo Verde.

Source of supply: The countries in table 18 are crucial players to grain security for the region. The West Africa countries in the table are suppliers of maize to the region.

Table 19: Source countries for West Africa imports

North America	Europe	CIS	Asia	Latin America and Caribbean	Africa
United states	France	Ukraine	Thailand	Argentina	South Africa
Canada	Germany	Hungary	Vietnam	Brazil	Benin
	Belgium	Uruguay	China		CÃ´te d'Ivoire
	Netherlands	Russia	India		Niger
	Italy		Pakistan		Ghana

Source: author (2014)

The regions dependence ratio of 9.1% on imports to fill its domestic demand gap implies that majority of its population will be insecure should crises arise from these countries.

Interpretation of findings to literature

West African region has the potential to increase its maize production. According to Storper (1992) a country or region is successful in the world economy when its share of world export of a specific product is greater than its share of world trade. The implication to West Africa is to optimise, the comparative advantage of maize production as a measure to increase its world market share of grains traded.

Storper 1992 affirmation implies that quality and value addition is essential for rising share of world export for the region. Demont (2013), Hoering (2013) and Storper (1992) among other literatures have indicated that the reduction of consumer preference towards imported grains can be attained with quality and value addition that could raise the image and standard of locally produced grains to outcompete the imported grains.

The high import dependency ratio of West Africa's importing countries raises food security issues and vulnerability of feeding its growing population. It therefore indicates that import dependency has threat for food security and the macro-economic stability of these importing countries. Demont (2013) indicated that when consumption increases and food production does not keep pace with it, the resultant effect is food crises and insecurity. The author further indicated that the 2008 food crisis has shown that this dependency has serious risks for food security and stability of the region.

5.1.3 Answer to research sub question 3

Characteristics of production and location factor as determinant of import

Q. What production and location factors (orgware; software; hardware) determine grain import dependency for West Africa?

In answering this question, an analysis of the agriculture production indicators from faostat and location indicators from GCI was analysed using OLS and fixed and random effect models. The three models were used to test the robustness of the results.

Lessons learnt from the literature by Huggins and Thompson (2013), Martin and Sunley (2006), and Davies (2011) shows that regional growth differences are shaped by social, economic and institutional contexts. Huggins and Thompson, (2013) concentrated on knowledge as the input or resource that stimulate growth processes, and that this determines a regions output within a specified time. Sunley and Martin, (2006) focused on the path dependence which is the indicator that shapes the ability of learning, adaptation and evolvement of regions to changing market trends. Davies (2011) concentrated on the ability and role of political or other societal actors to shape the regional capacities for resilience.

Malecki (2002) stated that soft network is the knowledge via social interaction gathered at different geographical scale, which are essential elements that improve technological capacity. This capacity demands hard networks. The decision making process concerning the location of these networks are in the hands of organisations. This he stated is essential to lock-out a path lock-in.

Within the above contexts, the production and location indicators were assessed and categorised under knowledge capital, institutions and infrastructure.

Interpretation of findings to literature

It was found that institutional ability has the most impact to enhance production and exports and for import reduction. It also has the most significant impact on improving production. This was followed by Knowledge capital which showed a significant impact to enhance production and exports potential and for import reduction. Infrastructure had the least impact on improving production and export and to reduce import.

The role of institutions to reduce import was found in the aspects of policy decisions and facilitating the availability of knowledge capital within and across regions. Institution ability has a 30% impact to reduce import.

In the aspect of policies, the number of procedures to start a business, the state of cluster development to enhance a country's position in the value chain, and ensuring a sound environment of the bank system to attract FDI, including the enhancement of production process sophistication are significant determinants, which can reduce the extent of import dependency.

These indicators confirm the organising capacities mentioned by Malecki (2002) which include leadership, vision and strategies, administrative organisation, political and societal support and a set of spatial economic conditions that will attract parties and actors to collaborate (Malecki, 2002).

The result of institutions as the most important factor to improve production, export and reduce import confirms Malecki (2002) findings that "the role of local institutions and their organising capacity reflects their ability to partner and recruit actors that will produce new and innovative ideas for conditions of sustainable growth and production.

The agriculture production indicators required for import reduction was in the area of R&D by higher education in the agriculture sector. This was critical in enhancing quality, value addition and grain productivity.

Determinants of grain imports for West Africa: From the above, the weakness of institutions (orgware) to facilitate the implementation of sound economic policies and evolve to changing market trends is a determinant of the regions import dependence. The enhancement of a sound banking system and the improvement of the regions position in the value chain in relation to cluster development have been the critical determinants for the import dependent nature of the region.

This is evident in the regions inability to improve production process sophistication to satisfy sophisticated demand, which has resulted in the increased import dependency of the region over the period reviewed. Furthermore, the inability of institutions to evolve in technology and to facilitate knowledge capital through research, including the attraction of FDI for knowledge absorption has increased the import dependent nature of the region.

Malecki (2002), Pendall et al., (2010) and Huggins and Thompson, (2013) confirmed the determinants indicators of import. These authors explained that the inability of institutions to developed schedules that effect the application of assimilated knowledge and absorptive capacities developed from external sources and through R&D influence the existing regional outcome of low grain production and high imports.

5.1.4 Answer to research sub question 4

Focus areas for improvement

Q. What production and location factors need to be improved to make countries less dependent and optimise grain production for food security in the West African region?

In answering this question, the significant indicators identified for import reduction and grain optimisation after the model analyses, were further modelled using the stepwise method in SPSS to find the order of importance and preference for indicator improvement.

Table 20: Summary of indicators for improvement

	Role of institution	Infrastructure	Knowledge capital
Import reduction and indicators for optimal grain production →	State of cluster development Soundness of banks Reliance on professional management Extent and effect of taxation Availability of latest technology Number of days to start a business	Fixed telephone lines/100 pop. Quality of electricity supply, Mobile telephone subscriptions/100 pop Individuals using Internet, % Available airline seat kms/week, millions	Availability of scientists and engineers Quality of scientific research Availability of research and training services, Production process sophistication University-industry collaboration in R&D FDI and technology transfer RnD investment by higher education in agriculture

Source: author, (2014)

The above indicators showed significant impact on reducing import dependency and increase production to enhance food security. The table presents indicators in their order of importance for policy recommendation and implementation.

The indicators identified for the improvement are also indicators on the competitive and resilient agenda. The implication is that for the region to reduce its import dependency, the institutional ability to evolve and effect the utilisation of knowledge capital and to induce the attraction of partners, actors and private sector is essential to the resilience of West Africa's food security and import reduction. As noted by Malecki (2002), Davies (2011) among other literatures, the institutional and political dimension is central to the improvement of grain optimisation, food security and regional resilience.

5.2 Interpretation of the findings and recommendations

Grain optimisation and regional resilience for West Africa

Maize and rice has a high potential for optimal production in the region. Optimal grain production would enhance the opportunity of trade-off, leading to the reduction of import value and the widening budget of most countries. The reduction of imports will also enhance the GDP of the region.

Domestic resilience in rice as noted by Demont (2013) requires the active role of institutions to actively participate in agriculture investment for value addition using agriculture

responsive policies and competitive strategies that will induce the attraction of entrepreneurs to enhance production process sophistication.

The sophistication of the production process of rice grown locally should aim at quality upgrading and branding in order to compete favourably on the domestic rice market to meet consumer preferences and taste. This will also require that competitive policies that attract FDI and technology transfer in the rice value chain are given critical consideration. This will enhance employment opportunities, whilst reducing import dependency thereby resulting in resilience and the extent to which import affects rice security for West Africa countries.

The role of institutions to improve market dominance by its local suppliers is important. It is also essential to make available technology critical to improving quality and yields in order to make products competitive in the domestic market. The initiation of policies to improve competition amongst local suppliers, increase the value chain effect of the region in cluster development and to ensure ultimately a sound bank system is the determinant of a food secured, less dependent and more resilient region. This will result in the achievement the MDG goals 1 and 8, which are to eradicate extreme poverty and hunger (1) and develop a global partnership for development (8).

Judging from above, the attempt of relocalising food production would increase local agro processing. Thereby creating spaces for local enterprises and entrepreneurs, either private or cooperatives, to move up the value chain by acquiring places on the shelves in shops and supermarkets, so far occupied by the products of foreign companies (Hoering, 2013 p.7).

5.3 Lessons learnt and recommendation for West Africa

In an argument put forward by Demont (2013) in her analysis of rice development strategies of some West African countries she indicated that the major challenge despite the various policy strategies on increasing domestic production is the neglect of processing and marketing in the grains supply chain.

The author's argument compliments and confirms the results of production process sophistication as an indicator that requires improvement and attention by the various institutions. The indicators under institutions such as regulations to start business and the soundness of the bank systems are indicators that enhance attractiveness to foreign direct investment and consequently technology transfer.

Even with enough barrier protection, to shelter domestic grains production from price fluctuations as argued by Demont (2013) and Hoering (2013), it is important to improve regional integration strategies for infrastructure.

As indicated by the results of this thesis infrastructure improvement especially in airline transport, fixed line and internet access is needed to expand market access for especially landlocked countries such as Burkina Faso, Mali and Niger. With the regions increasing policy measures in domestic grain production, the development of active trade routes and infrastructure services within and across countries will expand market access within the region.

5.4 Regional planning and food security for West Africa

The Global Competitiveness report, (2014, p.7) mentioned that it is important to strengthen the links between trade and trade services (telecommunication and transport). However, it is

also very critical to attract investment, since most global trade is now increasingly taking place in value chains. The strength of a country and or region lies in its overall policies. Hence the institutional ability to enhance an environment of competitiveness for investment cannot be over-emphasised. To this end, it is important for regional planning policies to incorporate spatial cluster of agriculture production and processing with input of high level knowledge and technology.

Regional planning should be decentralised to incorporate rural districts, which form the local supply source of most cities in the region. The spatial implications of the different location characteristics analysed in this research resonate to the concept of the metropolitan food clusters (MFC).

The cluster concept of metropolitan foodscape is a developing concept which can be tailored to suit contextual agricultural policies. The MFC is a spatial network of physical hub that builds knowledge and innovation. In integrated planning, the connection of the periphery with the urban core through the location of agro parks, rural transformation and consolidation centres; will enhance the optimisation of grains and it associated services in relation to the supply of market needs and other competitor quality. Refer to annex 6 for a conceptual diagram of the MFC.

5.5 Contribution of the research

A number of publications on regional resilience and competiveness have recognised the important role institutions and actors need to undertake to enhance a region's attractiveness to investment and growth. It has also been established from the literatures reviewed in this research that knowledge capital is important to enhance regional growth and development. In the context of import and increasing agriculture production, a number of literatures, reports and policy papers reviewed, have also stated that institutions, knowledge and network capital (FDI investment) are important to reduce import dependency and enhance production.

For scientific relevance: the research has identified from statistics the importance of institutions, infrastructure and knowledge capital and the extent to which these factors impact on imports, exports and production. The research has again proven that among the three indicators, institutions are a priority factor explaining the import dependence and the ability to improve domestic agriculture production. Knowledge capital was the next important, followed by infrastructure.

From the ensuing, it is the position of this study that institutions, infrastructure and knowledge capital have significant impact on reducing import dependency and increasing production thereby affirming the advocacy by Malecki (2002) and Brown et al., (2010). The study position also affirms the position of Malecki (2002), Simmie and Martin, (2009) and Davies (2011) that emphasised on institutions as central to effect the application of knowledge acquired through R&D and external sources to enhance production.

To policy relevance: the research have proven that the interrelatedness of the indicators categorised under the three factors (orgware, software and hard ware) encompass the entirety of policy initiatives that should be directed to reduce import dependency and regional resilience for food security. The fact that the impacts of the indicators are known should indicate to policy makers the urgency to restructure their adaptation mechanisms.

5.6 Lessons learnt

- The strength of major importers, who imports for purposes of trade, are enriched by their position in the value chain. The GCI report reiterated the importance of countries to operate in an environment, where the availability of well educated and healthy workforce operates in an efficient labour market and an institutional framework that increase its position in the value chain (GCI report, 2014).

- The strength of exporters is enshrined in their economic policy, efficient business procedures, and high level infrastructure that integrate easy movement, communication and research.

- It should be noted that the complementary effect of network structures (that is the interactions and ties) within and across regions, which is shared based on trust, knowledge and production processes will improve the strength of production and reduce vulnerability to grain insecurity.

- The transition of import dependent countries to self-sufficient domestic production requires governments boldness to stand up to measures that limits their ability to separate agriculture production and food sector from investment agreements and negative trade conditions (Hoering, 2013).

5.7 Further research

The resilience approach to ensuring food security provides different perspective for further study. This is because resilience approach highlights the short and long term adaptation to market trends and changing phenomenon. It also looks at the ability of actors to adapt to changing trends. An assessment of the significant indicators to identify its short- and long-term effect on imports and optimal production is a scope for further study.

The focus of the further study is to enhance decision making, with regards to which indicators have correlation as a short- or long-term measure on influencing optimal production and reducing imports. Several models could be used to analyse and estimate the speed and time it will take for the dependent variables such as potential to optimise grain production and the ability to reduce grain imports will adjust to a change in the independent indicators of institutions, infrastructure and knowledge capital. The analysis will provide opportunity for better recommendations to policy decisions.

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Annex 1: country classification

Europe

European Union	Other Europe	Other countries	Major developed economies (G7)
Austria	Iceland	Australia	
Belgium	Norway	Canada	Canada
Denmark	Switzerland	Japan	Japan
Finland		New Zealand	France
France		United States	Germany
Germany			Italy
Greece			United Kingdom
Ireland			United States
Italy			
Luxembourg			
Netherlands			
Portugal			
Spain			
Sweden			
United Kingdom			
New EU member States			
Bulgaria			
Cyprus			
Czech Republic			
Estonia			
Hungary			
Latvia			
Lithuania			
Malta			
Poland			
Romania			
Slovakia			
Slovenia			

Economies in transition from developing to developed region		
South-Eastern Europe	**Commonwealth of Independent States (CIS) and Georgia**	
Albania	Armenia	
Bosnia and Herzegovina	Azerbaijan	
Croatia	Belarus	
Montenegro	Georgia	
Serbia	Kazakhstan	
The former Yugoslav Republic of Macedonia	Kyrgyzstan	
	Republic of Moldova	
	Russian Federation	
	Tajikistan	
	Turkmenistan	
	Ukraine	
	Uzbekistan	
	Georgia officially left the Commonwealth of Independent States on 18 August 2009. However, its performance is discussed in the context of this group of countries for reasons of geographic proximity and similarities in economic structure.	

Developing economies by region		
Africa	**Asia**	**Latin America And The Caribbean**
North Africa	**East Asia**	Caribbean
Algeria	Brunei Darussalam	Barbados
Egypt	China	Cuba
Libya	Hong Kong SAR	Dominican Republic

Morocco	Indonesia	Guyana
Tunisia	Malaysia	Haiti
Sub-Saharan Africa	Myanmar	Jamaica
Central Africa	Papua New Guinea	Trinidad and Tobago
Cameroon	Philippines	Mexico and Central America
Central African Republic	Republic of Korea	Costa Rica
Chad	Singapore	El Salvador
Congo	Taiwan Province of China	Guatemala
Equatorial Guinea	Thailand	Honduras
Gabon	Viet Nam	Mexico
Sao Tome and Principe	**South Asia**	Nicaragua
East Africa	Bangladesh	Panama
Burundi	India	South America
Comoros	Iran (Islamic Republic of)	Argentina
Democratic Republic of the Congo	Nepal	Bolivia (Plurinational State of)
Djibouti	Pakistan	Brazil
Eritrea	Sri Lanka	Chile
Ethiopia	**Western Asia**	Colombia
Kenya	Bahrain	Ecuador
Madagascar	Iraq	Paraguay
Rwanda	Israel	Peru
Somalia	Jordan	Uruguay
Sudan	Kuwait	Venezuela (Bolivarian Republic of)
Uganda	Lebanon	
United Republic of Tanzania	Oman	
Southern Africa	Qatar	
Angola	Saudi Arabia	
Botswana	Syrian Arab Republic	
Lesotho	Turkey	
Malawi	United Arab Emirates	
Mauritius	Yemen	
Mozambique		
Namibia		
South Africa		
Zambia		
Zimbabwe		
West Africa		
Benin		
Burkina Faso		
Cape Verde		
Côte d'Ivoire		
Gambia		
Ghana		
Guinea		
Guinea-Bissau		
Liberia		
Mali		
Mauritania		
Niger		
Nigeria		
Senegal		
Sierra Leone		
Togo		

Source: World Economic Situation and Prospects 2012

The annex was prepared by the Development Policy and Analysis Division (DPAD) of the Department of Economic and Social Affairs of the United Nations Secretariat (UN/DESA).
Classification of countries into developed, transition and developing regions

Annex 2: Secondary data source for analysis from Faostat
http://faostat3.fao.org/faostat-gateway/go/to/download/FB/*/E

Annex 3: Table results of production and location indicators as determinants of world import, export and production output

Model analysis of production variables to import, export and production

Import value	Pooled OLS	Fixed effects	Random Effects
Population	0.00***	0.01***	0.00***
	(0.00)	(0.00)	(0.00)
ProdQtyTonnes	-0.00***	-0.02***	-0.01***
	(0.00)	(0.00)	(0.00)
Constant	206261.70***	-163715.50***	198954.00*
	(12274.52)	(58641.54)	(33789.21)
Observations 1219		(R^2=0.04), F (25.04) P < 0.001	

Dependent Variable: Import value *{Standard errors in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01}*

Export value	Pooled OLS	Fixed effects	Random Effects
ProdQtyTonnes	0.10***	0.06***	0.08***
	(0.00)	(0.01)	(0.00)
Population	-0.01***	-0.01	-0.00***
	(0.00)	0.00	(0.00)
ProdPriceIndex	606.14***	825.42***	664.73***
	(173.41)	(196.35)	(175.79)
Constant	-102929.60*	70017.92	-82011.72
	(52069.30)	(227518.2)	(79399.81)
Observations 803		R^2= (0.55), F (334.35) P < 0.001	

Dependent Variable: Export value {Standard errors in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01}

Production quantity	Pooled OLS	Fixed effects (FE)	Random Effects (RE)
Population	0.07***	0.10***	0.08***
	(0.00)	(0.02)	(0.00)
YieldHgperHa	60.32***	95.88***	94.63***
	(11.19)	(10.26)	(9.84)
AgriLand	16.22**	14.67	8.40
	(8.06)	(23.59)	(16.90)
Constant	-783258.51*	-2848136*	-1813837*
	(440545.5)	(1031676)	(963634.8)
Observations 1207		(R^2=0.57), F (525.22), P < 0.001	

Dependent Variable: ProdQtyTonnes *{Standard errors in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01}*

Source: author (2014) model analysis

Export (dependent)	Pooled OLS	Fixed effects	Random Effects
2.06 Available airline seat kms/week, millions	217.58*** (9.15)	551.68*** (72.78)	254.43*** (17.46)
2.09 Fixed telephone lines/100 pop.	16.38*** (2.62)	-3.53 (5.29)	8.19** (3.48)
1.20 Efficacy of corporate boards,	573.71*** (87.11)	64.66 (95.57)	180.72** (86.90)
6.07 No. days to start a business	-7.48*** (1.18)	0.90 (1.71)	-1.56 (1.41)
1.09 Burden of government regulation,	-376.73*** (60.24)	54.47 (76.93)	-146.06** (66.18)
1.19 Strength of auditing and reporting standards,	-157.44** (76.21)	-49.86 (88.17)	-32.75 (79.22)
1.01 Property rights,	-147.70** (60.87)	-89.19 (77.60)	-52.43 (65.58)
Constant	1667.70*** (352.19)	911.60 (570.38)	833.51** (402.31)
Observations (667) (R^2=0.66)			

Dependent Variable: Export {Standard errors in parentheses *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$}

Production	Pooled OLS	Fixed effects	Random Effects
10.01 Domestic market size index, 1–7 (best)	6481.09*** (918.45)	40.63 (394.40)	701.51* (376.81)
2.06 Available airline seat kms/week, millions	1.59*** (0.15)	2.20*** (0.28)	2.30*** (0.22)
6.15 Degree of customer orientation, 1-7 (best)	-7884.20*** (1144.10)	-192.53 (381.86)	-360.80 (394.22)
5.04 Quality of math and science education, 1-7 (best)	3982.97*** (593.55)	-223.95 (341.86)	-68.86 (343.73)
6.08 Agricultural policy costs, 1-7 (best)	4793.275*** (836.12)	113.88 (348.87)	198.48 (358.72)
11.04 Nature of competitive advantage, 1-7 (best)	-3792.20*** (611.79)	-562.68 (391.55)	-783.28* (385.14)
1.09 Burden of government regulation, 1-7 (best)	3766.41*** (869.85)	-248.22 (339.28)	-300.66 (348.07)
9.03 FDI and technology transfer, 1-7 (best)	-4006.41*** (894.25)	593.47* (358.93)	500.14 (368.94)
10.02 Foreign market size index, 1–7 (best)	2459.17* (956.01)	732.12** (309.71)	1130.77*** (305.23)
3.01 Government budget balance, %	-400.26*** (790.06)	10.17 (20.17)	5.91 (20.94)
3.02 Gross national savings, %	200.31*** (467.68)	17.16 (14.92)	25.84* (15329.53)
7.05 Pay and productivity, 1-7 (best)	2353.23** (868.40)	487.07 (353.66)	714.46* (360.62)
Constant	-26.07*** (4167.62)	-48.04 (3306.54)	-4434.40 (3178.03)
Observation (682)			

Dependent Variable: Production quantity {Standard errors in parentheses *$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$}

Annex 4. Characteristics of major exporters and importers

Major Exporters

	Pooled OLS	Fixed effects	Random Effects
Production factors	*Observation (366)*		
GDPperCapUSD	59.849***	54.90***	54.73***
	(4.23)	(6.82)	(5.92)
ProdQtyTonnes	0.027***	0.04***	0.03***
	(.003)	(0.01)	(0.01)
YieldHgperHa	-30.698***	-6.20	-13.52**
	(3.533)	(7.30)	(5.59)
(Constant)	399537.41***	-736282.71***	-298983.77
	(139991.58)	(279943.25)	(275721.89)
(R^2 0.44) F (97.25)			
Location factors			
2.06 Available airline seat kms/week, millions	207.39***	730.64***	269.18***
	(17.085)	(136.20)	(34.39)
6.06 No. procedures to start a business	-96.36***	-86.83*	-75.50*
	(27.77)	(37.16)	(32.84)
6.12 Business impact of rules on FDI,	-1016.06***	-271.81	-284.11
	(175.95)	(227.05)	(195.12)
6.05 Total tax rate, %	11.55***	1.50	2.39
	(2.19)	(2.56)	(2.20)
1.22 Strength of investor protection,	236.93***	-91.61	20.14
	(86.47)	(206.35)	(133.71)
9.03 FDI and technology transfer,	522.94**	336.11	348.10
	(223.77)	(239.78)	(232.24)
(Constant)	2161.70**	7858.63***	3649.42*
	(988.11)	(2215.67)	(1556.46)
Observations 217, $R^2 = 0.64$ F = (48.40)			

Dependent Variable: Export value {Standard errors in parentheses $*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$}

Major importers

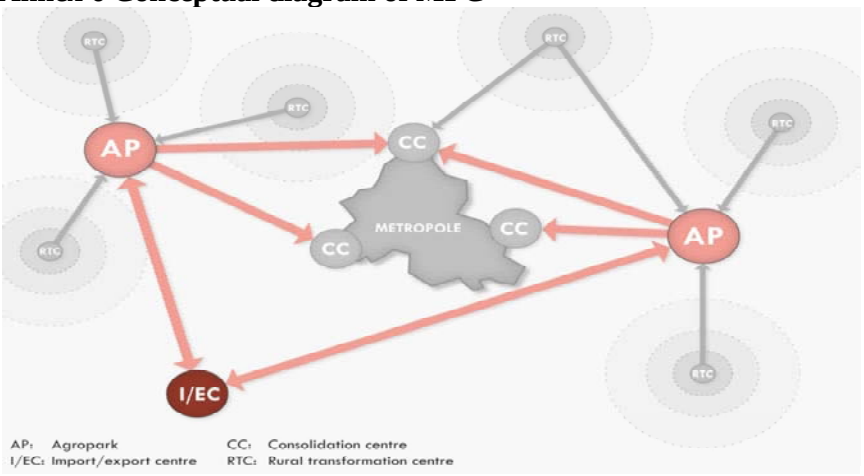
Import	Pooled OLS	Fixed Effects	Random Effects
Production factors	(*observation 330*)		
ProdQtyTonnes	-0.01***	-0.03***	-0.01**
	(0.00)	(0.01)	(0.01)
Population	0.00**	0.01***	0.00*
	(0.00)	(0.00)	(0.00)
Constant	489039.69***	-858869.85**	428410.72***
	(55393.27)	(362607.87)	(127725.21)
Location factors			
8.08 Legal rights index	-84.81***	-25.29	-45.42*
	(23.00)	(28.53)	(24.75)
11.03 State of cluster development	334.61***	230.68**	249.36**
	(80.26)	(105.17)	(88.38)
1.12 Transparency of government policymaking	-247.55**	-2.58	-49.65
	(102.85)	(97.05)	(90.26)
1.07 Favoritism in decisions of government officials	160.12**	70.20	68.73
	(78.15)	(111.33)	(90.52)
Constant	1017.45***	358.72	621.74
	(307.21)	(587.59	(412.96)
Observations 207, R^2 (0.16) (F (8.73) P < 0.01			

Dependent Variable: Import Value {Standard errors in parentheses *$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$}

Annex 5 Global competitive index used as location factors

http://www.weforum.org

Annex 6 Conceptual diagram of MFC



(Source Peter Smeets, 2014) Alterra Wageningen UR